

US Army Corps
of Engineers

DESIGN GUIDE

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DESIGN GUIDE
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CHAPTER 1

AUTOMATION TECHNICAL MANAGEMENT (SPECIFICATIONS, DRAWINGS, COST ESTIMATES, REVIEW COMMENTS)

1.0 PREPARATION OF SPECIFICATIONS

- 1.1. Unless otherwise directed, specifications shall be Corps of Engineers Guide Specifications (CEGS).
- 1.2. Specifications shall be prepared in accordance with ER 1110-1-8155 and ER 1110-2-1200.
- 1.3. In accordance with ER 1110-1-8155, specifications must be prepared using SPECSINTACT (see <http://www-de.ksc.nasa.gov/specsintact>).
- 1.4. Where CEGS are not available to cover a particular feature of work, guidance must be obtained from the Norfolk District to use specifications issued by other Government agencies (NASA, NAVY, etc.). Because non-Government specifications often contain provisions which are not in compliance with FAR (references to proprietary or brand name products, materials, or equipment), or contain standards incompatible with CEGS, use of such specifications are restricted. Where no master federal specifications are available to cover a feature of work, subject to Norfolk District approval custom specifications may be prepared using the SPECSINTACT format.
- 1.5. Guide specifications are available on the Internet at the Corps of Engineers TECHINFO address <http://www.hnd.usace.army.mil/techinfo/index.htm>. Guide specifications are also available on CD-ROM from the National Institute of Building Science's (NIBS) Construction Criteria Base (CCB). CCB is not COE-related so the CD-ROM is not available from the Norfolk District Office. The NIBS homepage is <http://www.nibs.org/nibshome.htm>.
- 1.6. Generally the specifications shall contain no provision that requires the Bidder or Offeror to make a submission of any type with his bid or offer. However, Request for Proposal type projects (i.e., design-build, complex projects requiring technical evaluation of Contractor competence and capacity) as determined by the COE may require submission of clearly specified evaluation documentation with offers. Design reviews will address applicability of all proposed submissions.
- 1.7. To permit free and open competition, use of proprietary and "brand name or equal" purchase descriptions are strongly discouraged, and the burden for justifying such descriptions is placed on the designer. If the AE intends to specify proprietary materials or equipment, provide J&A (justification and approval) in accordance with FAR Subparts 6.303 and 6.304, and ER 1110-1-8155. "Brand name or approved equal" specifications shall be verified with the CENAO Contracting Officer and District Counsel (through the CENAO Project Engineer/Architect) in accordance with ER 1110-1-8155, Part 9m. All submittals with proprietary specifications must include justification and approval documentation on official letterhead; all submittals with "brand name or approved equal" specifications shall include documentation from the appropriate CENAO level confirming brand name use is acceptable. Documentation is required only with the first submittal in which the products are specified. All design submissions including "brand name or equal" specifications must be accompanied by written documentation on A-E or other official letterhead fully justifying need for such specifications.
- 1.8. Submissions containing specifications shall as a minimum adhere to the following requirements:
 - 1.8.1. All sets of specifications shall be firmly bound by a method of the A-E's choice. Specifications loosely bound by rubber bands or placed unbound in a box are unacceptable.
 - 1.8.2. Specifications shall be prepared in SPECSINTACT containing a header on each page which identifies the project title, location, and file name.

1.8.3. Specifications shall have a cover containing as a minimum the project title, location and A-E's name, address, and date.

1.8.4. All Norfolk District solicitations will be issued in electronic format. See Section VI for specific requirements.

2.0 TABLE OF CONTENTS FORMAT

2.1. A specification table of contents (TOC) is automatically prepared when using SPECSINTACT.

2.2. Since a SPECSINTACT table of contents includes only SPECSINTACT-prepared sections, a typed TOC will be required when custom specifications are included. Format shall match a SPECSINTACT TOC.

3.0 PROCEDURE FOR PREPARATION OF AMENDMENTS

3.1. General

3.1.1. An amendment is a legally binding document describing revisions and additions to be incorporated into published bidding material (previous amendments, solicitations, specifications and drawings) prior to opening of bids or receipt of proposals.

3.1.2. Amendment items shall be clear enough to allow all bidders to revise bidding documents with a minimum effort. Ambiguous amendment items may cause inconsistent interpretations of revisions among bidders, resulting in poor bids.

3.1.3. The format for presenting amendment revisions in each category is similar, but revisions on drawings which cannot be adequately covered by descriptive amendment items require 8 1/2" x 11" sketches or revised drawings. Revised drawings will be discussed under Drawing Amendment Items below.

3.1.4. After descriptive amendment revisions and/or 8 1/2" x 11" sketches are issued, the A-E shall incorporate all changes on the CADD drawing files prior to award of contract.

3.1.5. All amendments shall be submitted in both hardcopy and electronic format. File shall be Word 97 (or later) or in ASCII format to allow editing. (See Section VI for EBS requirements)

3.1.6. Further information or instructions shall be obtained through the Project Architect/Engineer. Under no circumstances is the A-E to contact the technical sections for information or guidance.

3.2. Descriptive Amendment Items

3.2.1. Descriptive amendment items give bidders directions on revising words, sentences, paragraphs, tables, schedules, etc., previous amendments, specifications and drawings to clarify or augment bidding documents.

3.2.2. Except as specified in this guidance, all amendments shall be provided to the COE in a ready-to-be-issued form. The A-E shall fully review and proofread amendments prior to sending to the COE to ensure accuracy. Amendments found to contain excessive ambiguities or inaccuracies, as determined by the COE, will be returned to the A-E for revisions.

3.2.3. Page numbers are to be shown as "PAGE X OF YY PAGES." The first page of the A-E's amendment shall be "2" as the COE adds a standard Government cover page identifying the project. Page headers on specifications shall match those of the original solicitation.

3.2.4. The heading of each category in which a change is made (AMENDMENTS, SPECIFICATIONS or DRAWINGS) shall be typed in capital letters and underscored.

3.2.5. All individual amendment items shall be numbered sequentially, beginning with the first item in the first category and ending with drawings. If the last specification amendment is numbered "110," the first drawing amendment shall be numbered "111." Do not begin number "1" when moving from one category to another.

3.2.6. Items under each category shall be listed in chronological order according to either their page and paragraph numbers or NDFN numbers. When referencing drawings use only the NDFN number, not the sheet number or both NDFN and sheet numbers.

3.2.7. Under the category "Amendments" all revisions to previously amended portions of either the specifications, drawings or earlier amendments are to be covered. Items under this category shall reference the amendment number and item number of the previously issued amendment to be revised (i.e. Amendment No. 0003, Item 25). Only the exact portions of the bidding document to be revised are to be addressed under the "Amendment" category. If, for example, a single word or phrase is amended, in either specifications or drawings, only this word or phrase shall be revised again in a subsequent amendment. For drawings, if a sketch (see drawing amendments below) is issued showing a revision, subsequent amendments shall amend the sketch, referencing only the amendment which included the sketch, not the other portions of the drawing amended by the sketch. To avoid contradictions or redundancies the A-E should be familiar with previous amendments and have electronic and printed copies of each for reference when preparing new amendments.

3.2.8. Attachments may be substituted for information in the body of the amendment to provide revised tables, schedules or large paragraphs. This method allows the A-E to revise portions of a specifications already in a word processor and simply print it out. All attachments shall be on pages no larger than 8 1/2" x 11". Do not include any attachments which must be folded by the COE printing facilities as these will adversely increase printing time.

3.2.9. All attachments shall be dated and the date shall be referenced in the descriptive amendment item to which the attachment applies (i.e. "...in accordance with Sketch SK-1, dated Jun 27, 1999.").

3.2.10. Unless an agreement is made with the COE, all attachments should be consecutively labeled "Sketch SK-1", "Sketch SK-2", etc., even if they are tables/schedules or series of paragraphs and each shall be dated.

3.2.11. Each attachment and its date shall be listed on the last page of the amendment under heading "ATTACHMENTS." When listing multiple consecutive numbered sketches, it is not necessary to list each individually but as follows: "Sketches SK-1 through SK-2, dated Aug 15, 1997."

3.3. Drawing Amendment Items

3.3.1. If drawing amendments have revisions which require showing such features as floor plans, riser diagrams, site plans or other drawing features which cannot be adequately revised descriptively, it may be necessary to issue pictorial sketches or completely revised drawings. These sketches may also include Tables and Schedules. The following methods are recommended:

3.3.1.1. Make all changes on the original drawings, then print the changes onto no larger than 8 1/2" x 11" sheets to accompany the descriptive portion of the amendment. These are considered attachments and are also covered in Items 8 through 11 under DESCRIPTIVE AMENDMENT ITEMS above.

3.3.1.2. If changes cover too large an area to show clearly on an 8 1/2" x 11" sketch, send the revised drawing to the Norfolk District office in a CALS file similar to the original drawings and it will be reissued in its entirety. Drawings reissued in their entirety shall be revised in accordance with Item 3 below prior to issuance to bidders. Full size revised drawings are also considered attachments, but shall be referred to in the descriptive portion of the amendment and in the ATTACHMENT list as "Sheet M-1, NDFN FL321-1.22, or Sheet P-1, NDFN FL321-1.18, etc., not "Sketch SK-1", "Sketch SK-13". As with multiple 8 1/2" x 11" sketches discussed above, drawings may be listed in the attachment list as follows: "Revised Sheets 1, 5, 12 through 23, 34 and 72, dated Aug 15, 1997" or "New Sheets 10, 17, 45 and 47, dated Aug 15, 1997."

3.3.2. When providing sketches with pictorial revisions be sure the quality of the print is high. The purpose of a pictorial revision is defeated if the quality is too poor to permit clear reproduction and provide legible copies to bidders.

3.3.3. All revised drawings must identify in full all areas where changes were made. Below are the instructions for identifying amendment revisions on drawings:

3.3.3.1. Revisions to drawings shall be alphabetically identified by a, b, etc., and surrounded by a circle. Only this symbol is to be used to indicate location of revisions in the body of the drawing. This symbol is also used to identify construction contract modifications to drawings and its use is discussed in Part VII under subheading "Procedure for Preparation of Contract Modifications."

3.3.3.2. All revisions made on the drawings shall be identified by the revision identification symbol shown in the revision block.

3.3.3.3. If the number of revisions to a single sheet is so great as to make identifying circles impracticable, place the circle at the title of the feature revised.

3.3.3.4. The revisions on each drawing shall be identified by a number according to the following:

3.3.3.4.1. If the revision block has no previous amendments or contract modifications the first revision shall be identified by a, the second revision by b, etc.

3.3.3.4.2. If the revision block contains previous revisions, the identifying letter in the circle shall be the next in sequence, not the amendment number.

3.3.3.5. Amendments shall be described in the revision block as shown on the SAMPLE TITLE BLOCK. Since the same symbol is used for both amendments and construction contract modifications the A-E shall denote the type of revision in the revision block.

3.3.3.6. Show the date of the modification in the revision block.

3.3.3.7. Revision block shall be initialed by the A-E office making the change.

3.3.3.8. The SAMPLE TITLE BLOCK is found at the end of this guidance package.

3.3.3.9. A sample amendment sketch is attached at the end of this guidance package.

4.0 A-E INSTRUCTIONS FOR DEVELOPING CONSTRUCTION CONTRACTOR SUBMITTAL REQUIREMENT

4.1. General: The A-E shall prepare a list of submittals required for each project on ENG FORM 4288, Submittal Register, as specified in instructions for CEGS 01330 SUBMITTAL PROCEDURES. This form shall be prepared electronically using SPECSINTACT. If a submittal register is prepared for non-SPECSINTACT specifications, format, graphics and typeface must be the same as the SPECSINTACT-prepared form. Determination of submittals on this form shall be in accordance with ER 415-1-1, which distinctly requires the designer to be very specific to allow the construction Contractor to know exactly what it is that is required to be submitted. Citing only the general submittals in Part 1 of specifications is insufficient for the required level of specificity. This completed form will become a part of CEGS 01330 SUBMITTAL PROCEDURES.

4.2. Submittal Classification: Most guide specifications include paragraphs requiring the Contractor to submit various items to the Government (see submittal categories in CEGS 01330 notes). These submittals are either classified "Government Approved" or "Information Only." Submittal classification may be determined by applying the following guidance (see also ER 415-1-1):

4.2.1. Government Approved Submittals: Generally, submittals listed in the specifications which shall be designated "Government Approved" on the submittal register fall into the categories listed below:

- a. Extensions of design.
- b. Any items of equipment whose compatibility with the entire system must be checked.
- c. Critical materials and major items of equipment.
- d. Deviations from the contract documents.

4.2.2. Information Only Submittals: All other submittals not meeting the requirements for Government Approved shall be considered "Information Only."

4.3. A-E Responsibility:

4.3.1. The A-E shall use SPECSINTACT tagging to include in the specifications the appropriate "Government Approved" or "Information Only" designations, and reviewer (in accordance with ER 415-1-1). Submittal registers generated in SPECSINTACT will contain the proper information for each specification.

4.4. Submittal Register for Review: The complete ENG FORM 4288, Submittal Register, shall be included in the specifications no later than the final review (inclusion at an earlier review stage may be either in accordance with the A-E scope of work or at the A-E's discretion).

5.0 INSTRUCTIONS FOR PREPARATION OF CONTRACT DRAWINGS

5.1. GENERAL INSTRUCTIONS

5.1.1. Unless otherwise specified in the A-E's contract, drawings must be planned, drawn and lettered using Corps of Engineers standards as specified below. Hardcopy mylars or electronic graphics standards are available from the COE Project Engineer/Architect. Drawings shall be in accordance with ER 1110-345-700, Appendix C, "Drawings," and other criteria or guidance furnished by the Government as part of the design contract.

5.1.2. Drawing Sizes: Drawing sizes shall be as specified below:

5.1.2.1. Civil and Military: Concept and final design drawings, and drawings for standard and definitive designs, shall be prepared on standard A1 metric size sheets, 594 mm x 841 mm (23.39" x 33.11") should be used; an American National Standards Institute (ANSI) "D" equivalent sheet.

5.1.2.2. Specifications: There will be projects where it is neither practical nor cost effective to use "D" size drawings. Such projects may need only a minimal number of drawings, include simplified plans, elevations, profiles or details, and may be adequately shown on sheets attached to the end of the specifications (these are not to be confused with such drawings as lighting fixture details or other drawings which are an integral part of individual specifications). Such drawings shall be A4 metric size, 210 mm x 297 mm (8" x 11"), an ANSI "A" equivalent sheet, and must be legible. No fold-out drawings are permitted. If such small drawings are proposed, consult the CENAO Project Engineer/Architect for guidance.

5.1.3. All CADD (Computer-Aided Drafting and Design) drawings for advertising must be plotted on mylar and must contain all graphics (border, title blocks, Corps logo, signature block, index of drawings, etc.) as on standard Corps mylar. Floppy discs with cover sheet formats and other graphics and standards are available from the COE in AutoCAD format. Drawings in the specifications addressed above may have modified graphics if approved by the Norfolk District, and shall be available in an electronic format.

5.1.4. On drawings being issued as hardcopies, do not use shading or screening on drawings. Shading often appears as solid black on half-size bid drawings and obscures internal detail. Use symbols or varied line thicknesses to show those areas A-E usually shows with shading or screening.

5.1.5. Cover sheet must have project title and location in large letters above index of drawings. Location map and vicinity map must have North arrows and graphic scale bars.

5.1.6. Index of drawings must contain interdisciplinary sheet numbers, consecutive Norfolk District File Numbers (NDFN), project drawing number and individual sheet titles.

5.1.7. Sheet titles in the Index of Drawings and the individual title boxes must read verbatim. Abbreviations are permitted only if space does not allow full sheet titles.

5.1.8. Sheet numbers should use a letter prefix referencing the discipline (i.e. C-SV1, C-SV2 for Civil Survey Drawings; A-FP1, A-FP2 for Architectural Floor Plan Drawings, etc.) and shall be inserted in the allotted space in the index of drawings and title boxes.

5.1.9. NDFN numbers should run consecutively (i.e. FL102-1.1, FL102-1.2, FL103-1.3, etc.) in both title boxes and index of drawings.

5.1.10. Prime A-E logo shall be only located in undesignated rectangle to the left of the title block "Drawing Number" space. Do not place an excessively large logo elsewhere in the drawing area of the plates and do not provide logos of subcontractors.

5.1.11. All full or partial site or floor plans must show north arrows. If several plans are oriented in the same geographical direction only one arrow is necessary.

5.1.12. If site plans or floor plans require half-toning to make distinctions between such features as new and existing work, be sure the half-toning is not too light. Half-toning which is too light may not print on half-size bid drawings.

5.1.13. No portion of the drawing shall extend beyond the borders of the drawing area or extend into the title block.

5.1.14. This generally applies to drawings issued hardcopy. Except for lettering on location and vicinity maps, and other lettering permitted to be smaller by the COE (i.e., on COE-furnished electronic surveys for site plans), all lettering must be at least 1/8" high on unreduced D Size drawings to be readable.

5.1.15. For both review and advertising purposes, when drawing thin lines representing such features as site plans or floor plans (where new work or electrical/mechanical features are made with heavier lines for emphasis) make the line density heavy enough to be visible on all media. Sometimes bluelines show thin lines so faint that personnel conducting drafting reviews will assume linework on mylars is equally faint and request A-E to increase line density.

5.1.16. Use only upper case letters when composing body type (i.e.: notes, schedules, tables, legends, etc.).

5.1.17. Show a graphic scale bar for each different scale used on an individual drawing. It is not necessary to show a scale bar at individual details, sections or profiles on a single sheet if the scale is the same.

5.1.18. Dates in the title blocks must be the same on all sheets.

5.1.19. A project drawing number for the project will be provided by District Personnel during review of concept or preliminary plans.

5.1.20. All CADD files shall conform to the A-E/C CADD Standards (<http://tsc.wes.army.mil>) unless superseded by job-specific CADD standards.

5.1.21. All drawing information to be included in project solicitations will be advertised in electronic format in accordance with the EBS initiatives. CADD drawings developed in support of a project will require submission to the Government in ".CAL" format to facilitate EBS posting. See Section VI for additional information.

6.0. INSTRUCTIONS FOR INCORPORATING CONTRACT MODIFICATIONS ON ORIGINAL TRACINGS.

6.1. General: A contract modification is a document describing revisions and additions to be incorporated into the project during the construction period.

6.1.1. Before changes are made the A-E is to assure that a copy of the original CADD file is available showing conditions prior to the change about to be made.

6.2. REVISIONS: Revise original tracings as follows:

6.2.1. Revisions to drawings shall be alphabetically identified by an appropriate number surrounded by a circle as shown on the attached SAMPLE TITLE BLOCK. Only this symbol is to be used to indicate location of revisions in the body of drawing. This symbol has previously been used to identify drawing amendment items as described in Part III under subheading "Drawing Amendment Items."

6.2.2. All revisions made on the drawings shall be identified by the revision identification symbol shown in the revision block.

6.2.3. The revisions on each drawing will be identified by a number according to the following:

a. If the revision block has no previous amendments or contract modifications the first revision shall be identified by a, the second revision by b, etc.

b. If the revision block already contains revisions the identifying letter shall be the next in sequence regardless of whether the previous letter identified an amendment or contract modification.

6.2.4. A description of the revision shall be concisely described in the revision block and the change identified as a contract modification to distinguish it from an amendment revision.

6.2.5. Show the date and the modification number in the revision block.

6.2.6. Draw a cloud around each change.

6.2.7. Clouds around previous changes shall be removed and new clouds drawn around current modifications.

6.2.8. Revision block shall be initialed by the A-E office making the change.

6.2.9. A SAMPLE TITLE BLOCK (while the title block sample attachment does not depict the contract drawings' title blocks, the sample revision blocks above this attachment is to be used as guidance in completing the actual contract drawings' revision blocks) is found at the end of this guidance package.

7.0. DRAWINGS AND SPECIFICATIONS FOR SOLICITATION

7.1. Specifications:

7.1. Specifications for all projects will be advertised as an electronic bid set (EBS) and shall be furnished in portable document format (PDF – see <http://www.pdfzone.com>). Specifications shall also be provided in hardcopy and shall be single-sided as printed by SPECSINTACT, shall be unbound and shall not have holes punched in the left margin.

7.1.2. Submittal Register for Advertising: The completed submittal register shall be a single PDF file including registers for all sections. If the project is issued hardcopy the submittal register shall be the original SPECSINTACT-generated document. Submittal register shall contain no punched holes.

7.1.3. Specification Deliverables: The A-E shall submit on CD-ROM a copy of all specifications in both the native SPECSINTACT (.sec) format and in processed .pdf format for posting on the EBS site. The CD-ROM shall contain the following items:

- a. A label indicating project name, number, location, and submittal date.
- b. A directory containing the native SPECSINTACT files for all contract specifications sections.
- c. A directory containing the processed specification files in .pdf format for all specification sections.
- d. A directory containing a single file which shall represent the assembly of all individual specification sections, table of contents, attachments, soils information, lead and asbestos survey information, submittal register, etc. into a single file. This file will represent the complete technical specification package.
- e. Single file assembly may be completed using Adobe ACROBAT or ARCOBLD. The first sheet of the assembled file shall be a cover sheet with project name, number, location, and date prepared.

7.2. Contract Drawings

7.2.1. General. All Contract Drawings provided shall be accomplished and developed using computer-aided design and drafting (CADD) software and procedures conforming to the following criteria. In addition to the electronic versions of the contract drawings required later in this paragraph, the A-E shall provide original mylars of all contract drawing sheets which include the A-E's professional seal and each sheet signed.

7.2.2. Graphic Format. All CADD data shall be supplied in three-dimensional, AutoCAD, release 14 native electronic digital format (i.e., .dwg) and readable on the MS-NT 4.0 operating system. The A-E shall ensure that all digital files and data (e.g., base files, reference files, block libraries) are compatible with the Government's target CADD system (i.e., basic and advanced CADD software, platform), and adhere to the standards and requirements specified herein. The term "compatible" means that data can be accessed directly by the target CADD system without translation, preprocessing, or post processing of the electronic digital data files. It is the responsibility of the A-E to ensure this level of compatibility.

7.2.2.1. In addition to the above graphic format, each contract drawing must be supplied (plotted or scanned) in a CALS Type raster file (.CAL) at 400dpi. CALS drivers for AutoCAD are available for free download from AutoDesk Inc as well as from the Corps of Engineers TECHNINFO site. The submitted CALS raster files shall be exact duplicates (proper scale, line weights, quality etc.) of the normally submitted contract drawings hard copy (blue line or mylar) set and will be distributed to bidders instead of paper copies (blue lines). There will be one CALS file submitted for each drawing sheet in the set. Each CALS file shall be named to reflect its sheet number following A-E/C file naming standards (alpha numeric without spaces or dashes and no more than eight characters total, for example drawing A-2 would be named a02.cal). A-E is shall ensure that the file naming convention for the CALS files allows the files to be listed in the proper order. For example, T-1 and T-2 would become A0T1.cal and A0T2.cal and so on. Each discipline would begin with a different letter and the individual files in that discipline numbered sequentially. In any case, when the files for the project are shown on the directory list they shall be in the appropriate order.

An ASCII text file of the index of drawings cross referenced to the raster file name shall be submitted in the following space delineated format:

Filename.cal	Sheet number	Sheet title as shown in the drawing index for example:
A01.cal	A-1	First Floor Plan
A02.cal	A-2	Second Floor Plan

7.2.3. CADD Standards. CADD drawings shall be prepared in accordance with the applicable provisions of the "A-E/C Standards." Standard drawing size shall be D-size using the electronic standard border supplied by the Government. CADD drawings, details, and data shall be prepared in accordance with the above graphic

format, with any additional job-specific CADD standards included with this document and utilizing any electronic standards (cell libraries, symbol libraries, font libraries, etc.) that may be supplied by the government. The A-E shall submit a written request for approval of any deviations from the Government's established CADD standards. No deviations from the Government's established CADD standards will be permitted unless prior written approval of such deviation has been received from the Government.

7.2.4. Electronic Delivery and Media Format. One separate set of CALS files along with the EBS index shall be delivered to the Government on electronic digital media at the RTA submittal. Two separate sets of all CADD data and files developed under this contract shall be delivered to the Government on electronic digital media at project completion. The CADD files shall be updated to reflect all amendments. All electronic digital data, CALS raster files and CADD files shall be provided on compact disc, read-only memory (CD-ROM) following ISO 9660 format. Each set on its own CD. The electronic digital files delivered shall be in their original file format as previously specified, which can be read and processed by the Government's target CADD system directly from the CD. No compression or backup utilities will be used to store the files on the CD-ROM.

The external label for each electronic digital media shall contain, as a minimum, the following information:

- (1) The Contract Number (and Delivery Order Number if applicable), project title, and date.
- (2) The format and version of the CADD system software.

BEFORE A CADD FILE IS PLACED ON THE DELIVERABLE ELECTRONIC DIGITAL MEDIA, THE FOLLOWING PROCEDURES SHALL BE PERFORMED:

- (1) Remove all extraneous graphics outside the border area and purge the drawing file of any superfluous layers, fonts, linetypes, and blocks. Zoom drawing and set layers to the plot ready state (ie. drawing border fills screen and no layer manipulation is required to reproduce the plotted sheet).
- (2) Make sure all reference files are attached without device or directory specifications.
- (3) Include all files, both graphic and nongraphic, required for the project (i.e., font libraries, reference files, etc.). No text fonts shall be used that are not included with the base CADD package.
- (4) Make sure that all support files such as those listed above are in the same directory and that references to those files do not include device or directory specifications.
- (5) Include any standard sheets (i.e., abbreviation sheets, standard symbol sheets, etc.) necessary for a complete project.
- (6) Insure that file naming conventions, layer naming assignments and entity color to plot pen widths adhere to the "A-E/C Standards."
- (7) Incorporate all amendments. The CADD files must be updated to include all amendments including amendments issued by description or sketch.

7.3. Documentation Transmittals

7.3.1. A transmittal letter containing, at a minimum, the following information shall accompany each electronic digital media submittal to the Government. The transmittal letter shall be dated and signed by the appropriate Contractor's representative. The transmittal letter shall be provided to the Government on 8-1/2-inch by 11-inch paper. An electronic copy of the transmittal letter in a DOS ASCII Text format shall also be provided on the electronic digital media submitted to the Government.

7.3.1.1. The information included on the external label of each media unit (e.g., CD), along with the total number being delivered, and a list of the names and descriptions of the files on each one.

7.3.1.2. Certification that all delivery media are free of known computer viruses. A statement including the name(s) and release date(s) of the virus-scanning software used to analyze the delivery media, the date the virus-scan was performed, and the operator's name shall also be included with the certification. The release or version date of the virus-scanning software shall be the current version which has detected the latest known viruses at the time of delivery of the digital media.

7.3.1.3. A statement indicating that the A-E will retain a copy of all delivered electronic digital media (with all files included) for at least one year and, during this period of time, will provide up to two additional copies of each to the Government, if requested, at no additional cost.

7.3.2. In addition, the Contractor shall provide the following "Plot File Development and Project Documentation Information" as an enclosure or attachment to the transmittal letter provided with each electronic digital media submittal. The "Plot File Development and Project Documentation Information" shall be provided to the Government on 8-1/2-inch by 11-inch paper. An electronic copy of this information in a DOS ASCII Text file format shall also be provided on the electronic digital media submitted to the Government.

7.3.2.1. Documentation for each drawing which will be needed to be able to duplicate the creation of the hard copy plot by the Government at a later date. This documentation shall include the plot scale, drawing orientation, drawing size, and any other special instructions.

7.3.2.2. List of any deviations from the Government's standard layer scheme, file-naming conventions and entity color to plot widths. Any deviations must have been previously approved by the Government.

7.3.2.3. If applicable Metadata Files shall be created for any surveys or other geospatial data created during the design process. These files shall adhere to all file standards and data structure requirements as directed in EC 1110-1-83; "Policies, Guidance, and Requirements for Geospatial Data and Systems" and Executive Order 12906.

7.4. Ownership.

7.4.1. The Government, for itself and such others as it deems appropriate, will have unlimited rights under this contract to all information and materials developed under this contract and furnished to the Government and documentation thereof, reports, and listings, and all other items pertaining to the work and services pursuant to this agreement, including any copyright. Unlimited rights under this contract are rights to use, duplicate, or disclose text, data, drawings, and information, in whole or in part in any manner and for any purpose whatsoever without compensation to or approval from the Contractor. The Government will at all reasonable times have the right to inspect the work and will have access to and the right to make copies of the above-mentioned items. All text, electronic digital files, data, and other products generated under this contract shall become the property of the Government. By reference, the following DFAR clauses are included in the design contract as a part of the requirements herein:

- a. DFAR 252.227-7013, "Rights in Technical Data and Computer Software."
- b. DFAR 252.227-7018, "Restrictive Markings on Technical Data."
- c. DFAR 252.227-7019, "Identification of Restricted Rights Computer Software."
- d. DFAR 252.227-7028, "Requirement for Technical Data Representation."
- e. DFAR 252.227-7037, "Validation of Restrictive Markings on Technical Data."

8.0 COST ESTIMATES

8.1. Cost Estimates.

8.1.1. General. All construction cost estimates prepared shall be completed in MCACES, latest edition. Cost estimates for all submittal phases shall be in MCACES. All submissions shall be in both hardcopy and CD-ROM electronic file format. All necessary files and supporting information shall be included to allow the Government to review, edit, and update the cost estimate as necessary.

8.1.2. Submission Format. A transmittal letter containing, at a minimum, the following information shall accompany each electronic digital media submittal to the Government. The transmittal letter shall be dated and signed by the appropriate Contractor's representative. The transmittal letter shall be provided to the Government on 8-1/2-inch by 11-inch paper. An electronic copy of the transmittal letter in a DOS ASCII Text format shall also be provided on the electronic digital media submitted to the Government.

8.1.2.1. The information included on the external label of each media unit (e.g., CD), along with the total number being delivered, and a list of the names and descriptions of the files on each one.

8.1.2.2. Certification that all delivery media are free of known computer viruses. A statement including the name(s) and release date(s) of the virus-scanning software used to analyze the delivery media, the date the virus-scan was performed, and the operator's name shall also be included with the certification. The release or version date of the virus-scanning software shall be the current version which has detected the latest known viruses at the time of delivery of the digital media.

8.1.2.3. A statement indicating that the A-E will retain a copy of all delivered electronic digital media (with all files included) for at least one year and, during this period of time, will provide up to two additional copies of each to the Government, if requested, at no additional cost.

9.0 REVIEW COMMENT MANAGEMENT

9.1. DrCheck.

9.1.1. General. Beginning in October 2000 North Atlantic Division has required that all military projects will be managed for design quality utilizing the DrChecks review comment management system created by CERL. This system will require all designers, specification writers, reviewers, and managers to work within this system to create, edit, categorize, and respond to design review comments. Also included in this system is a Lessons Learned database as well as a Value Engineering Flag which can be set on particular comments.

9.1.2. All personnel involved with design production, review, and solicitation for the Norfolk District will need to utilize DrCheck in some phase of their work. No special hardware or software is required to access and utilize this system.

9.1.3. Norfolk District will provide basic training in the DrCheck system on an as needed basis beginning in the September/October time frame. Use of this system on military projects is mandatory.

----END OF CHAPTER----

CHAPTER 2

ENVIRONMENTAL CONSIDERATIONS

1.0 GENERAL.

Give the maintenance and enhancement of environmental quality full consideration early in the design process. Insure that the project is designed in full compliance with all environmental regulations applicable to the project. Areas of concern include:

- . Air Quality
- . Water Quality (Land Disturbance/E & S Plan)
- . Noise Control
- . Solid Waste Disposal
- . Hazardous Wastes
- . Historic Preservation
- . Archaeological Resources
- . Threatened and Endangered Species
- . Wetland Mitigation

2.0 SUBMITTAL REQUIREMENTS.

Provide a listing of all applicable permits, licenses and any other authorizations required to construct and operate the project on an Environmental Permit Matrix (see blank form, instructions for completion, and sample completed form at end of *this* appendix.) Base the completion of the form on a compliance review of the proposed projects based on applicable areas of concern listed above, and their specific regulations. Where proposed projects do not require any environmental permitting or licenses, submit a letter to the COE with the 30% Submittal certifying the engineer's conclusions.

2.1 30% Submittal Requirements.

For each permit required, provide the following information on the environmental permit matrix:

- a) Permitting authority (Federal, State and/or local), P.O.C.'s, addresses, telephone numbers.
- b) Type permit authorization required.
- c) Procedure and time necessary to process permit.
- d) Fee schedule - to include filing/application fees, charges for actual emissions and fees relative to testing of abatement equipment toward insuring compliance with environmental requirements.
- e) Data and or studies required.
- f) Outline of approach for obtaining permit information (attach to matrix).

Notify the District of any major discrepancies existing between the design criteria provided by the COE and the pollution abatement criteria.

2.2. 60% Submittal Requirements.

2.2.1 Permits. Provide completed applications prepared for COE signature and any other required documents for all permits, licenses and/or authorizations required for construction/operation of the facility including but not limited to the following:

- Solid Waste Disposal
- Sanitary Landfill
- Toxic Hazardous Waste Storage, Transportation, and Disposal
- Wastewater Discharge/Storm Water Discharge
- Open Burning
- Incineration
- Locating, Constructing and Operating related facilities
- Stationary Source Operation
- Noise Generation
- Cultural Resource Disturbance
- Biological Resource Disturbance
- Visual Resource Disturbance
- Land Disturbance

Prepare all supporting material required for the applications including emission surveys, diagrams, pollutant load calculations, etc. Furnish copies of all correspondence from permitting agencies which either detail permit requirements or indicate that no permits are necessary.

2.2.2 Storm Water Pollution Prevention Plan (SWPPP). Where included in Appendix A of the design contract, provide a SWPPP to control sediment in the storm water runoff coming from the drainage area in and around the construction site. The permit will be obtained by the Government after receipt of the final corrected construction documents from the A-E. Construction activities covered by the SWPPP include any clearing, grubbing, grading, excavating, or filling activities that result in disturbance of the site.

2.2.2.1 Description: Include in the SWPPP a site description of the construction project with erosion and sediment controls to be implemented by the construction contractor. The SWPPP is part of the contract documents and the construction contractor will be required to sign a contractor compliance statement.

2.2.2.2 Records and Inspections: Specify in the contract documents that the construction contractor will be responsible for field level quality control and that the contractor inspect all erosion and sediment controls on the site at least once every seven calendar days and within 24 hours after any storm event greater than 12 mm (0.5 in) of rain per 24 hour period. In addition, specify that qualified contractor personnel must inspect, weekly, the construction site to identify areas contributing to storm water discharges associated with construction, and evaluate whether measures to prevent erosion and control pollutants are adequate.

2.2.2.3 Content: The required content of the SWPPP is usually contained in a state's environmental protection regulations for authorization for storm water discharges associated with construction activity under the NPDES. For projects within the Commonwealth of Virginia, the designer shall make full use of Requirements and Standards/Procedures cited in latest issue of Virginia Erosion and Sediment Control handbook issued by Virginia Department of Conservation and Recreation and VR 680-14-19, Virginia Pollutant Discharge Elimination System issued by Virginia Department of Environmental Quality. Additional information is included in Engineering Circular (EC) III0-1-80, Handbook for the Preparation of Storm Water Pollution Prevention Plans. Examples of items to include are:

- Engineer Certification Statement
- Purpose of Plan
- Project Location
- Description of Site and Construction Activity
- Runoff Coefficient
- Receiving Waters
- Erosion and Sediment Controls

- Stabilization Practices
- Structural Practices
- Anticipated Sequence of Activities
- Storm Water Management
- Maintenance and Inspection
- Erosion and Sediment Control Practices
- Other Controls
- Waste Disposal
 - Waste Material
 - Hazardous Waste
 - Sanitary Waste
 - Offsite Vehicle Tracking
- Demonstration of Compliance with Federal, State, and Local Regulations
- Inventory of Materials or Substances Onsite
- Spill Prevention Plan
- Spill Prevention Practices
- Product Specific Practices
 - Petroleum Products
 - Fertilizers
 - Paints, Solvents, and Sealants
 - Concrete Trucks
- Drawings, Tables, Figures, and Details
- Installation/Construction Practices
- Maintenance and Inspection Practices

3.0 INSTRUCTION FOR COMPLETING ENVIRONMENTAL PERMITS STATUS MATRIX.

3.1 Purpose. The purpose of the *Matrix* is to allow the Government to track the status of environmental permits required for military *projects*. The Matrix is designed to show what was done by the A-E and/or Design Agent. The Matrix is designed to establish accountability for determining permitting requirements.

3.2 Procedure. For the Matrix to work effectively, all items must be completed as follows:

Project: *Title*

Installation: *Post/Base*

FY: *Fiscal Year of Project*

PN: *Project Number*

Determination Completed By: *Name of individual (and Organization) accountable for the determination.*

Specific Items/EOP Evaluated: *Indicate specifically which parts of the project, i.e., equipment, e.g., paint spray booth, diesel fuel tank, etc., were examined for permitting requirements. If there are no items which could possibly require permitting, the N/A column should be checked. A statement must also be included... as shown on the example.*

Permit Required (Y/N/NA): *If Yes, indicate in the "Y" column how many permits are required. If no, Mark N in column. If the project will not impact a specific environmental parameter, mark the N/A column and explain (as shown on example).*

Regulatory Agency Contacted: *Identify the regulatory agency contacted. Include regulator's name(s), address, telephone number, and dates of contact. Ensure the appropriate regulatory agency*

is contacted, i.e., don't expect the air pollution board to know about permitting requirements for underground tanks, etc.

Permit Fee: *Indicate the amount of dollars which must accompany the permit application. This should be determined when the regulator is contacted.*

Comments: *Insert whatever is necessary to clarify what has or has not been done.*

3.3 Resubmittal. Incomplete Matrices (Applications) or permit applications which are obviously erroneously prepared will be returned to the A-E for completion.

----END OF CHAPTER----

CHAPTER 3

GEOTECHNICAL REQUIREMENTS

1.0 GEOTECHNICAL INFORMATION – COE PREPARED

1.1 General Procedure: Geotechnical investigations will normally be accomplished through the District's GeoEnvironmental Engineering Section. On a per project "exception only" basis, geotechnical investigations will be made part of the A-E contract. When geotechnical investigations are not part of the A-E design contract, results of such investigations, including relevant geological data, foundation design criteria, pavement design parameters and other required project specific information will be provided to the A-E by the District's GeoEnvironmental Engineering Section in the form of a Geotechnical Report. Upon request a concept report (informal) will be provided to the A-E containing preliminary foundation recommendations based on a file search of available subsurface information in the general project area. The official Geotechnical Report which presents site specific design criteria and recommendations will be provided after explorations and laboratory testing are completed, and no later than two weeks after the A-E has been given notice to begin final design. The A-E will provide an additional site plan "mylar" with the 30% submittal on which the actual exploration program will be based and the location of explorations will be shown. The approved site plan shall show the existing utilities, topography and structures, coordinate grid system, and location of major design features.

1.2 Data: The District will provide the A-E, for incorporation into drawings, actual exploration locations, subsurface exploration logs and laboratory test data for incorporation into the contract specifications. If requested, the Geotechnical Report will also include percolation rates, resistivity readings, corrosion potential, radon testing or other geotechnical information required for project design. Use the geotechnical information and design criteria to complete the preparation of the project's design documents.

2.0 GEOTECHNICAL INFORMATION – A-E PREPARED

2.1 General Procedure: Geotechnical investigations will normally be accomplished through the District's GeoEnvironmental Engineering Section. On a per project "exception only" basis geotechnical investigations will be made part of the A-E design contract. When the geotechnical investigation is made part of the A-E design contract, obtain such information by using a competent and reputable geotechnical firm specializing in such work. Adequate subsurface information shall be obtained and recommendations presented for use by designers' of structures, grading, drainage, and other design features meeting the District's criteria. Before negotiation of the design contract, furnish recommendations as to extent and type of subsurface investigations the geotechnical firm proposes. Scope of these services will be agreed upon by the District's GeoEnvironmental Engineering Section, prior to becoming part of the A-E design contract. Provide copy of completed Geotechnical Report to COE for review within two weeks of completion. The A-E's field and laboratory operations may be subject to inspections by the COE as considered appropriate. Show location of soil boring logs on contract drawings. Include soil boring logs and laboratory test data in contract specifications.

2.2 Architect-Engineer Responsibilities: When required by contract the A-E is responsible for preparation of the following:

- (1) Subsurface exploration
- (2) Soils testing
- (3) Geotechnical Report-Foundation and/or Pavement Design Analysis

2.3 Site Visit: The A-E is also expected to visit the site to determine by all means available, including examining data at the office of the DPW/BCE, where, and to what extent, unsuitable material can be expected.

3.0 GEOTECHNICAL INVESTIGATIONS

3.1 General: A geotechnical exploration is performed to obtain specific subsurface data at the site and to provide foundation and earth recommendations for the proposed project. The data should include the depth, thickness, extent, and composition of each stratum, and the groundwater conditions.

3.1.1 Submission of Drilling Program: The A-E should complete the "Proposed Geotechnical Exploration Data" sheet (see Exhibit 44 of this Guide) outlining the proposed scope of exploration and return it as an attachment to the fee proposal before negotiation of the original contract. The character and extent of the exploration should be designed in consideration of the importance of the structure to be constructed. The "Proposed Geotechnical Exploration Data" sheet is merely a guide for the exploration and is flexible; the final program should develop as information accumulates in order to obtain the greatest amount of useful information in the most cost-effective manner.

3.2 Method of Exploration.

3.2.1 The field investigation should consist of a series of soil test borings. The number and spacing of the borings depends upon the type of structure as well as the uniformity of the soil formations. The spacing should be smaller in those areas subjected to heavy loads and greater in less critical areas. Generally, a minimum of four soil test borings is required for building structures. The borings should penetrate all soil strata within the depth of influence of the structural loads, including shallow and deep foundations, and area loads such as fills or embankments. If design or subsurface conditions warrant, core samples should be obtained to verify the character and continuity of the "refusal" material. Borings located in pavement areas normally need only extend to 1.5 m (5 ft) below the ground surface or design grade, whichever is deeper.

3.2.2 In conjunction with the soil test borings, the standard penetration test should be performed to obtain disturbed soil samples for classification testing and to get an indication of the density of cohesionless soils and the strength of cohesive soils. Disturbed samples are generally taken continuously for the first 3 m (10 ft), then at every 1.5 m (5 ft) or at each change of material. The static, or Dutch, cone penetration test can be performed to complement the soil test borings. If, quantitative laboratory testing is anticipated, relatively undisturbed thin-walled tube samples should be taken (75 mm (3 in) diameter). Bag samples of auger cuttings should be collected from pavement and borrow areas to investigate the compaction characteristics of the soil. Groundwater readings should be taken upon completion of drilling and 24 hours after drilling is completed. In unusual circumstances (e.g., where deep excavations are anticipated in areas of high groundwater), observation wells should be installed to monitor the groundwater level.

3.2.3 All soil and rock samples taken during the exploration are to be retained by the A-E until the Geotechnical Report is approved. Upon approval of the Geotechnical Report, the soil and rock samples shall be turned over to the government.

3.3 Laboratory Testing of Soil Samples.

3.3.1 The laboratory testing program should be designed to facilitate analysis of the subsurface conditions on the basis of factual data. The program should include classification tests to identify the soils within the Unified Soil Classification System, measure their physical properties, and enable an estimation of the behavior of the soils based on empirical correlation's. Classification testing should include visual examination, moisture content and Atterberg limits determinations, and, when appropriate, grain size analyses and unit weight measurements.

3.3.2 The allowable soil bearing pressure and the expected settlement of the structure shall be determined. Quantitative laboratory tests such as the unconfined compression, and consolidation, should be performed on undisturbed soil samples as required to assist in these analyses.

3.3.3 More sophisticated field and laboratory studies should be performed only if warranted by the complexity of the project. Such field studies include pressure meter measurements, plate bearing tests, and geophysical explorations; laboratory tests include triaxial, California Bearing Ratio, direct shear, and permeability tests.

3.4 Presentation of information in Contract Documents: Soils information obtained from field logs, laboratory tests and geologist's logs should be included in the contract specifications in the form of final boring logs,

laboratory test data summary sheets, and explanatory notes. Soils boring locations shall be shown on the contract drawings. It is particularly important that complete subsurface information such as dates, location coordinates, elevations, depths to rock, stratigraphy, soil and rock descriptions, depths to groundwater, drilling equipment used, and the presence of unsatisfactory materials, etc., be presented to the contractor for bidding purposes. When subsurface exploration is performed by the Government, final logs will be prepared and furnished to the A-E. It is imperative that all information shown on these final logs and in the general notes appears in the contract specifications to protect the Government from contract claims.

4.0 GEOTECHNICAL REPORT.

4.1 General (References): A foundation analysis is required to show that the type of foundation selected is the most feasible one capable of supporting the structure. The Geotechnical Report must include a narrative describing the design approach and all estimates and assumptions made, as well as soil bearing and settlement calculations IAW the guidelines and general requirements of TM 5-818-1/AFM 88-3, Chap. 7 entitled, "Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures)."

4.2 Basic Design The Geotechnical Report shall be submitted at the 30% stage of design. The written report is prepared after the project information has been reviewed and the collective subsurface information has been analyzed. All conclusions and recommendations should be supported with appropriate calculations and/or discussion. The report should include:

4.2.1 a review of information on existing structures in the area;

4.2.2 a review of the area geologic conditions and site topographic features;

4.2.3 a review of the subsurface stratigraphy with the results of all testing conducted;

4.2.4 a general evaluation of the site considering the proposed project and the estimated subsurface conditions;

4.2.5 comprehensive foundation and earthwork recommendations, including bearing capacity and settlement calculations and discussions to support the recommended foundation system; and

4.2.6 a pavement design analysis with optimum layer thicknesses pavements shall be designed to satisfy the strength and frost criteria of TM 5-809-12, 5-822-5, and 5-822-6; drainage of the pavement base and subbase courses should be designed IAW TM 5-820-2.

4.2.7 if requested, the Geotechnical Report will also include percolation rates, resistivity readings, corrosion potential, radon testing, or other geotechnical information required for project design.

5.0 GUIDE SPECIFICATIONS.

5.1 Standard Change: The Norfolk District may require some changes be made to the standard CEGS. These changes will be incorporated into a Modmaster version of the applicable specifications which are furnished to the A-E. These standard changes should be used with judgment, and some will require editing to meet specific project requirements.

5.2 Satisfactory/Unsatisfactory Material in Earthwork Specifications: The A-E should review all subsurface information and make determination of which soil types are satisfactory and which are unsatisfactory with respect to the project requirements.

6.0 PLANS.

6.1 Standard Details: Standard details used by this office for preparation of plans are included in ExhibitS 47 through 52. These details should be used where required.

6.2 Data: Where applicable, the allowable soil or rock bearing pressure should be shown on the plans. This pressure should be indicated in such a manner that it is understood that the pressure is the design (allowable) pressure used in sizing the foundations and that this pressure is not the ultimate pressure which the soil or rock can withstand.

6.3 Physical Features: Show all physical surface features of the site such as rock outcrops, wet areas (swamps, marshy areas), sanitary landfills, existing pavement condition, etc. This information can influence the design, construction, and bidder's estimate of the earthwork, foundations, and paving features of the project.

----END OF CHAPTER----

CHAPTER 4

CIVIL/SITE DEVELOPMENT ENGINEERING

1.0 GENERAL.

1.1 Scope of Work: This chapter states criteria requirements for the site development portion of the project's civil site development design. Site development includes all proposed site improvements, excluding utilities other than storm drainage, and gravity flow sanitary sewers installed outside the 1.5-m (5-foot) line of the building(s) or structure(s). These improvements include, but are not limited to: demolition and salvage; clearing and grubbing; site grading, paving, storm drainage; stormwater retardation/treatment; turfing; grassing; fencing; landscaping, when required. Prepare a landscaping design that is comprehensive and coordinated with pertinent aspects of the overall site development. Include Using Activity requirements and consider the architecture of adjacent existing and proposed structures. Accomplish the site development according to appropriate design criteria referenced applicable publications.

1.2 Specific Requirements.

1.2.1 Field Trip Report. At the beginning of project design, make a site reconnaissance inspection to determine what impact the Site Development portion of the project design will have on the existing site conditions. Prepare a report of this field trip, including documentary photographs, and included with the Site Development portion of the 30% Design Submittal.

1.2.2 Site Adapts. Site adaptations of similar project designs approved for other locations are acceptable, provided the site adapt complies with the design criteria contained herein.

2.0 APPLICABLE PUBLICATIONS.

2.1 Army/Air Force Basic References.

2.1.1. Army. Architectural and Engineering Instructions (abbreviated AEI), Design Criteria (For Use in Military Construction Programs).

2.1.2. Air Force. AFR 88-15 (Draft), Criteria and Standards for Air Force Construction.

2.1.3 All Services. Uniform Federal Accessibility Standards (UFAS) and The Americans with Disabilities Act of 1990 (P.L. 101-336).

3.0 PRE-CONCEPT/PROJECT DESIGN (10%) SUBMITTAL REQUIREMENTS.

3.1 Ten Percent (10%) Design Submittal Requirements. For Site Development, furnish the following items:

3.1.1. Location Plan and Vicinity Map. This shall consist of an appropriate portion of the Installation's General Site Plan furnished by the Norfolk District, on which the proposed location of the facility being designed will be shown. Indicate location of project site, designated haul routes, and construction contractor's access to the site and the designated borrow and disposal areas.

3.1.2. A sketch of the proposed project site showing the "existing" topography (if available), (scale, spot grades, etc.). Identify any bordering/adjacent roads and streets, also any "existing" structure, utility lines, or other site feature(s) that may impact the proposed project.

3.1.3. Conceptual layout of new roads, drives, sidewalks, stormwater retardation basins, fencing, solid waste container pads, parking and their relationship to existing features and the new facility(ies).

4.0 CONCEPT/PROJECT DEFINITION (30%) DESIGN SUBMITTAL REQUIREMENTS.

4.1. 30% Design Analysis: Include a brief narrative covering the following items, as applicable to project design.

4.1.1 General.

- a. Location of and access to the proposed project site, with brief explanation of objectives and factors influencing siting decisions.
- b. General overview of major planned site features, including: building, orientations; surface draining patterns; traffic circulation; parking provisions and pedestrian access, including provisions for the physically disabled; security requirements; etc.
- c. Impact of new construction on existing facilities and considerations for future expansion.
- d. Existing site features, including: general topography, tree cover, acreage, boundaries, unusual subgrade conditions, etc.
- e. Former use of the site when major removals, demolition, and salvage are required.
- f. Requirements for flood protection, if applicable.
- g. Locations of borrow and disposal areas, either on or off the military reservation.
- h. Location of Best Management Practice (BMP's) for stormwater.

4.1.2 Demolition and Removals.

- a. Specifies requiring removal, relocation or demolition and salvage.
- b. Disposition of salvaged or waste materials.

4.1.3 Site Geometry.

- a. Rationale for locating major site elements.
- b. Specific clearance of setback requirements (Reference the "Installation Design Guide" for the particular military Installation, or applicable TM/AFM).
- c. Roads (Location and Layout).
 - (1) Traffic volume and type.
 - (2) Particular AASHTO design vehicle for which turning movements are to be provided, and corresponding minimum turning radius required.
 - (3) Maximum Design speed, degree of curvature, control grades, and sight distance requirements for road networks, when required.
 - (4) Lane and shoulder widths and cross slopes, as per the applicable TM/AFM.
 - (5) Road embankment slopes and back slopes in cut.
 - (6) Requirements for curbs, sidewalks, guardrail, traffic signs and markings, fencing, bicycle lanes, etc, as specified in appropriate TM/AFM/VDOT.
 - (7) Intersection(s) or connection(s) to existing roads, streets or parking areas.
 - (8) Surface drainage features, both existing and proposed.
 - (9) Easements and Rights-of-way (existing and new).
 - (10) Traffic routing during construction.

d. Parking (POV or MEP) and Open Storage Areas.

- (1) Size, type, and number of vehicles (if available or known) to be accommodated, as estimated by Using Activity.
- (2) Number and size of individual parking spaces to be provided, including pedestrian access and number and location of parking spaces for the physically disabled, when required.
- (3) General location of parking or storage areas, including location of entrance and exit drives.
- (4) Use of 90 degree, 60 degree, or 45 degree parking spaces and relation to anticipated traffic operation.

e. Miscellaneous Site Features.

- (1) Concrete curbing and curbs and gutters (locations and types).
- (2) Sidewalks - Estimated volume of pedestrian traffic, required width and locations, as specified in appropriate TM/AFM.
- (3) Fencing - justification, type, height, size and location of gates.
- (4) Traffic signs -types and locations.
- (5) Pavement markings -types, locations, spacing, and whether or not flecorized striping will be required.
- (6) Guardrail and wheel stops -location, length, and type of material(s).
- (7) Curb cuts for ADA accessibility.
- (8) Bicycle lanes/trails – location, width, pavement markings

f. Railroads spurs, when specified in project design.

- (1) Type of service for which track will be provided including loading.
- (2) Anticipated volume of rail traffic.
- (3) Maximum grade(s) and degree of curvature, as per applicable TM/AFM.
- (4) Features of track construction such as thickness and type of ballast, weight of rail, dimensions of cross ties, size of turnouts, etc.
- (5) Special requirements for track scales, bumpers, signals, grade crossings, derailer, pollution control, etc., as required.

4.1.4 Site Grading.

- a. Existing site features affecting grading, such as: buildings, streets, curbs, walks, fences, water courses, ponds, elevation of anticipated high water, rock outcrop(s), etc.
- b. Design flood frequency and minimum finished floor elevation required to provide the desired level of flood protection. Cite finish floor elevation of existing adjacent/nearby buildings or facilities. One hundred flood elevation.
- c. Attempt to balance cut and fill requirements.
- d. Unusual excavation requirements and rough estimate of cut and fill quantities, plus slope stability analysis (cut and fill) and justification for any slopes steeper than 4H:1V.

4.1.5 Storm Drainage Design.

- a. Select design values to be used in the storm drainage design calculations, including: rainfall intensity, based on the appropriate 10-year, 1-hr storm frequency, unless otherwise instructed; surface runoff and retardance coefficients, etc.

- b. Selected storm drainage plan with respect to planned connections to the existing storm drainage system when applicable.
- c. Alternate concepts considered in arriving at selected storm drainage plan.
- d. Considerations for future expansion and transient upland flows through site from above the project site.
- e. Principal means of collection and disposal of storm water in the new storm drainage system. Include "brief order of magnitude" calculations for runoff and estimated sizing of pipe and drainage structures.
- f. Method proposed for handling roof runoff from gutter downspouts (splash blocks or roof drain collector system).
- g. Connections of building's mechanical drains to outside drainage system, where applicable, and cross referencing to the appropriate section and design discipline, when required.
- h. Locations and features of special storm drainage structures, when required. Use of stormwater retardation/retention basins on-site where area permits. Liberal use of swales/sumps to retard stormwater should be encouraged.
- i. Types of materials to be specified for storm drains, culverts and structures, allowing full range of options of suitable materials for each installation.
- j. Easement requirement, when applicable.

4.1.6 Pavement Design: Do not accept, verbatim, pavement and base course thicknesses if given in the PDB/RAMP. Determine the required pavement thickness by a pavement design analysis IAW procedures specified in the applicable pavement design manuals and in Exhibit 22 and 23 of this Guide. Include:

- a. Brief description of general soil conditions on the project site.
- b. Design thickness of Vehicular Pavements.
 - (1) Specific design values for which pavement thickness is based, including: the anticipated number, type frequency and maximum weights of vehicles; category of traffic; class of road or street; and assumed Design Index, "DI".
 - (2) Flexible Pavements --The required thickness of Asphaltic Concrete and aggregate base shall be based on the assumed subgrade CBR and DI, noted above.
 - (3) Rigid Pavement --required thickness of nonreinforced portland cement concrete [(150 mm (6 in) minimum) having a minimum 28 - day flexural strength of 4478 kPa (650 psi)] and the assumed modulus of subgrade reaction "K".
- c. Military Airfield Pavements. Airfield pavement design, requiring aircraft operation criteria, is accomplished only by the Corps of Engineers.
- d. Coordinate airfield pavement designs and design criteria with Transportation Center of Expertise at U.S. Army Corps of Engineers, Transportation Center, Omaha, Nebraska.

4.1.7 Landscape Design: Include an analysis of existing site conditions, as well as indication of existing plant materials that are to remain on the project site. Point out specific site problems related to proposed development and the rationale for proposed plant selection and locations. Also include a list of suggested types

and sizes of plant materials which are to be used, based upon the Installation's approved plant list and the designated functional and visual criteria requirements.

4.2 30% Design Drawings. Include the following:

4.2.1 Location Plan and Vicinity Map.

4.2.2 Project Site Plan Geometry: This consists of a "composite" drawing(s) of the separate drawings compiling this design presentation (topography, layout, grading and drainage, foundation plan, electrical exterior, communications, landscaping, etc.), at the same scale (1:300 or 1:200)(1" = 30' or 1" = 20') and covering the same area as the topographic survey sheets. Show the foundation plan outline (print) of all structures (existing and proposed), including building numbers, on or immediately adjacent to the site, and all trees that have been determined by field survey to be worth saving and incorporating into the project design. Show actual ground contours existing on the project site at the same contour interval as the topographic survey sheets. Show the proposed finish grade contours tied into the existing ground contours. Indicate the extent of anticipated grading and area disturbed by construction to the existing site terrain and tree cover. Show all future structures and associated facilities within a reasonable proximity of the project site. Show all existing and proposed utility lines and structures required to serve the project, including: water, sanitary sewer, storm drainage, electric power, as service, fuel service, high temperature and chilled water. If applicable, show all telephone and other communication lines, and any and all other utility support items. Size these utility lines and structures in the best engineering judgment at this 30% stage without making a complete design analysis. Identify each utility by a symbol in a legend on the drawing(s). Show all existing and proposed driveways, parking areas, can wash locations, garbage storage and pick-up pads, and any other items necessary for functional and operation adequacy, including typical roadway and pavement sections.

- a. Show the proposed geometry of the project site plan using a minimum scale of 1:300 (1"= 30"), unless otherwise instructed. Provide sufficient geometric information to adequately locate all new site elements. Include the existing topography that will remain after construction is completed.
- b. Show and identify all existing buildings, utilities and other facilities on and adjacent to the project site.
- c. Use contrasting symbols (easily) differentiating between new and existing site work.
- d. Show benchmark and project baseline locations and list horizontal, and vertical/monument control/location data for each.
- e. Include a north arrow, with site preferably oriented with North arrow pointing toward the top of the sheet.
- f. Show the complete storm drainage system, using either grade contours or slope arrows and estimated size(s) of storm drainpipe.
- g. Show the proposed finished floor elevation of all new buildings and critical finish grade spot elevations at building corners, along sidewalks, edges of paved areas, etc., to assure positive drainage to storm drain inlets. Show approximate finish floor elevations of existing nearby structures/buildings.
- h. Include existing utilities with the site topography, If necessary for clarity, show removals, relocations, and new work for utilities other than storm drainage on separate plan(s).
- i. Base the thickness of typical flexible/rigid pavement sections on assumed compacted subgrade CBR/K values that, in the best judgement of the engineer, will provide adequate support for the type of pavement being designed. Base estimates on data obtained from the Using Activity (DPW or BCE) of the vehicles anticipated to be using the roads, drives, parking area(s), etc. of the proposed facility.

j. For Site Development, the term " Site Plan " applies only to the 30% Design submittal. For the subsequent 60% and Final Design Submittal the composite Site Plan will be expanded into separate site plan unless otherwise instructed by the Norfolk District.

4.2.3 Landscape Plan: When required, this consists of a narrative including a list of the major plant types to be in the project design. Also include a drawing showing a small portion (at least one building and one open area) of the project site to indicate the Landscape Architect's ideas or intent. For the overall design approach, as applicable, depict factors which affect existing site features and influence subsequent design proposals. Prepare the 30% drawing(s) at the same scale and include an appropriate legend, north arrow and graphic scale, same as the project site plan.

4.3 Outline Specifications: Select and include the outline specifications to be used in the Site Development portion of the project design from the list of, Modmaster/CEGS and speciality item specifications provided in this Guide.

4.4 Additional Information: A tabulation by the A-E of any design data not received that, in the judgment of the A-E, will be needed in order to proceed to completion of final design and preparation of complete bidding documents without interruption or delay, when directed to proceed with final design.

5.0 PRELIMINARY (60%) DESIGN SUBMITTAL REQUIREMENTS.

5.1. Include the following items:

- (1) Generally completed Site Plan Drawings, including landscaping when required.
- (2) Design analysis for storm drainage and pavement design.
- (3) Outline/draft project specifications covering all items of Site Development work shown on the drawings.
- (4) Estimating Function.
- (5) A list of any additional design criteria needed to complete final design.

5.2. Proceed from 30% to final project design, incorporating approved and provided comments received from review of the 30% Design Submittal. Consider the following Grading, Paving, Storm Drainage, and Landscaping items in the 60% Design stage:

- (1) Economical development of suitable building sites.
- (2) Satisfactory collection and disposal of surface runoff.
- (3) Preservation of the natural character (aesthetics) of the terrain of project site by minimum disturbance to existing ground levels to conserve trees and reduce extent of sediment runoff and potential erosion.
- (4) Reasonable balance of cut and fill to reduce cost of removal and disposal of excessive excavation, or securing additional borrow material to avoid unsightly fills that will unnecessarily increase the height of the building - foundations, and require costly erosion control measures.
- (5) Avoiding wavy profiles in streets and walks.
- (6) Avoiding excessive grades or steps in sidewalks, whenever possible.
- (7) Where rock or other unyielding material is encountered close to the surface, keep the finished grade(s) as high as practicable to reduce cost of excavating utility trenches

5.3. Specific.

- (1) Coordination. Closely coordinate all phases of the project design, (i.e., foundation/geotechnical, architectural structural, mechanical, sanitary sewage, water and electrical) with the Site Development (grading and paving layout). Tie locations of sidewalks, drives and parking areas, as well as finish grade elevations around building(s) into the requirements shown on the architectural drawings. Unless otherwise instructed, concrete

pads, electrical substations, cooling towers and other such items as required in the project layout must be shown on the Grading Plan to assure a complete grading design.

(2) Landscape design, when required, consists of preparing landscape plan studies and complete drawings and specifications for the project. Base the design on all general and specific criteria (drawings, manuals, etc.) contained or referenced elsewhere in this chapter.

(3) The "Checklist for Architect-Engineer's Review" included in this Guide is not intended to contain all the design requirements cited herein. However, it is intended to emphasize the important design criteria items may result in problems, if not included in this and subsequent design submittals. Use the checklist as a guide to assure that each of the listed items is included in the 60% and especially the final design submittal of the Site Development portion of project design.

5.4. 60% Design Analysis. Expand the 30% D.A. to support the 60% Design submittal, showing complete detailed analyses, date of initial preparation and names of preparer and checker. Include the following, as applicable to design:

5.4.1 Storm Drainage Design.

a. Complete storm drainage design calculations consistent with the requirements of the applicable state criteria and TM's, based on the design values presented in the 30% Design narrative and incorporating approved comments from the 30% Design Submittal.

b. Design Analysis. Design the storm drainage system and culverts to conform to the applicable local and state codes, TM's, and references specified herein.

(1) Design Criteria.

Design Storm. For the design storm index, use the 10-year 1-hour frequency intensity curve illustrated in the applicable TM/AFM and/or local highway department design criteria, in the area in which the project is located. Round off to the nearest 5 mm (1/10 in). For airfields, a 2-year design storm is usually required instead of the 10-year storm.

5.4.2 Pavement Design.

a. Present complete flexible and rigid pavement design calculations consistent with requirements of the applicable TM/AFM's, based on the various design values presented in the 30% Design Narrative and incorporating approved comments from review of the 30% Design submittal. For family housing projects local geographical vicinity criteria may be used for design.

b. Present complete calculations for pavement options, describing the nature of the materials to be used in each pavement structure.

c. A pavement design analysis is required to determine the thickness of flexible (bituminous) or rigid (concrete) pavements comprising drives, streets, parking areas, major on-post/installation highways, motor pool service areas, hardstands, aircraft parking aprons, taxiways, runways, interior floors, etc., when these features are indicated on the site plan. Follow the sample format included in Exhibit 22 and 23 of this Guide.

(1) Type of Pavement. Flexible pavement having a minimum thickness of 62 mm (2-1/2 in) bituminous surface course (hot - plant mix), and 200 mm (8 in) stabilized aggregate base course is usually specified for driveways and minor streets subject to light traffic and for passenger car (POV) parking areas. Thicker surface and base courses are required for the

higher class roads, streets, drives and vehicle parking areas subjected to considerable truck traffic with heavy loads, and shoulders of airfield runways and taxiways. Rigid pavement is used for tactical equipment shop hardstands, aircraft parking aprons and all service areas where spillage of solvents (gasoline, oil and grease) occurs as a result of service and repair of vehicles, aircraft, and airfield runways and taxiways. (Reference the applicable TM/AFM's concerning the type of pavement design required for the project).

(2) Traffic. Inspect the project site and confer with the Using Activity (DPW/BCE) to secure an estimate of the type and size of vehicle(s) and the total number of vehicles anticipated to use the proposed pavements. The estimated traffic volume and type, except for pavement features noted in the TM/AFM's, are necessary to determine the Design Index (D.I.).

(3) Subgrade Soil Values. Determine "CBR" and "k" values of the site soils from the Geotechnical Report.

(4) Flexural Strength of Concrete. Rigid concrete pavements are designed for a minimum flexural strength of 4478 kPa (650 psi) at 90 days for vehicles and 490 kPa (700 psi) at 90 days for aircraft. No other strengths specified in the design contract.

(5) Compaction Requirements. Designate the minimum depths of required compaction, based on procedures described/illustrated in the applicable TM/AFM.

(6) Provide a positive means of draining water from the aggregate base course (drainage layer) in all new pavement designs. Use underdrains or catch basin drains as shown in Exhibit 22 and 23.

5.4.3 Landscaping Design: When landscaping is required, revise the descriptive narrative, list of plant materials, and cost estimate from the 30% Design Submittal to correspond with the development of the 60% planting plan. Prepare the outline specification(s) and approximate grassing and plant list quantities for the 60% Design submittal utilizing the recommended Plant List for the Installation and incorporating approved comments from the 30% Design Submittal. Include quantities of grassing and plant materials in the 60% cost estimate.

5.5. 60% Design Drawings: Unless otherwise instructed in the design contract, expand the 30% Design Submittal composite Site Plan into the following separate site plans for this and the subsequent Final (90%) Design Submittal:

- a. Existing Topography Plan
- b. Demolition Plan
- c. Site (Layout) Plan
- d. Grading Plan
- e. Utilities Plan
- f. Paving Plan (if extensive pavement project)
- g. Sediment and Erosion Control Plan

Although the major items of work should be shown separately, different items of site work may be shown on the same sheet, provided the presentation is sufficiently clear to permit legible reproduction at half-scale. For small projects some of the above drawings may be combined.

5.5.1 Index of Drawings: Normally, the "Index of Drawings" is a separate sheet listing drawing numbers and titles. However, for some projects, the index information may be placed on the Location Plan if space is available.

5.5.2 Location Plan and Vicinity Map. (Normally completed by the 60% submittal, based on incorporation of approved comments from the 30% Design Review). Show the location of the project in relation to the overall

military reservation. This plan is usually drawn to a scale of 1:5000 to 1:10000 (1" = 400' to 1" = 800'). When projects are located on an established Government reservation, request a reproducible Site Plan from the PE/A use in preparing the Location Plan. Indicate the location(s) of permissible/designated access and haul routes through the reservation, and show designated earth borrow, disposal, or waste areas, when required for the project. Show configuration of the new work, with line item designation, prominently on the plan. Contact the BCE/DPW where the project is located and request the designated haul routes to the project and the location of a suitable borrow or disposal area, if available, on the Government reservation. Also, if needed for the project, indicate the permissible haul routes from the project site to these areas, and the area designated for construction contractor's material storage and field office(s) adjacent to or on the project site. If borrow and disposal areas are not available on the military reservation, add appropriate General Notes.

5.5.3 Existing Topography Plan: The Existing Topography Plan consists of a drawing or drawings prepared from the topographic survey sheets at the same scale as the composite "Site Plan" in the 30% Design Submittal. (preferably 1:300 (1" = 30'), but 1:200 (1" = 20') is also acceptable for small project sites). This plan should show all existing site features (topography, contours, structures, utilities, roads, etc), a minimum of 15 m (50 ft) outside site boundaries to show surface drainage. This plan should have a comprehensive site civil features legend and abbreviation used listing. Benchmarks shall be identified and shown. Datum used for vertical and horizontal control shall be cited/identified on topographic plan. Show the date and origin of the survey near the title block. In addition, include a legend showing all items of site work and reference same on all subsequent Site Plan drawings. Use an existing Topographic Plan only when there is not a demolition plan.

5.5.4 Demolition/Relocation Plan: To assure clarity of the Grading, Paving and Storm Drainage Plan, include an additional site plan showing removal, relocation, demolition and removal/salvage of existing buildings, roads, drainage structures, etc. Make this plan to the same scale as the "Existing Topography Plan." Add a note stating the Grading Plan shows the limits of clearing and grubbing and the area to be disturbed by the construction contractor's construction operations.

5.5.5 Layout Plan.

- a. Complete a geometric layout of all items of new site work, using offset dimensions from existing structures or a referenced construction base line (B/L) to be located in the field by the construction contractor and maintained throughout the life of the project. If necessary, use coordinates for locating new work, especially major road networks and building complexes.
- b. Locate or reference monuments for horizontal and vertical control for construction contractor's use in laying out the project. Cite reference for datum(s) used.
- c. Include references to standard figures, or reference particular details in the "Site Details" for specific items of site work. Unless modified herein, comply with disability requirements shall in the Uniform Federal Accessibility Standards (UFAS) and the Americans with Disabilities Act of 1990.
- d. Complete the legend to include symbols for all items of site work shown on the Layout Plan. Symbols should be consistent between successive drawings.
- e. On large projects preferably, exclude contour lines for ease of review.

5.5.6 Grading, Paving, Storm Drainage Plan, and Sediment and Erosion Control Plan.

- a. Indicate all items of new work, superimposed on the existing topography, including soil boring locations and designations from the boring location plan furnished by the District.
- b. Develop the Grading, Paving, Sediment and Erosion Control, and Storm Drainage Plan for each project site be developed on the existing topography at a scale of 1:300 (1" = 30') or 1:200 (1" = 20'), with the scale shown in the title block and also by graphic or bar scale.

(1) Exclude all new work involving water supply, electrical distribution, steam distribution and other exterior utilities, other than storm drainage and sanitary sewage. Show these utilities, excluding storm drainage, on the appropriate drawings of the other design disciplines. However, all existing utilities and features, must be indicated or identified by appropriate symbol in the legend.

(2) Earth shoulders of appropriate width should generally slope 4% (1/2 in/ft). Make cut and fill slopes for overall site work no steeper than 4H:1V, except for unusual conditions or cases where steep slopes are necessary to prevent encroachment on existing structures, or perhaps in remote outfall ditch areas. For roadway projects, base cut and fill slopes on 4H:1V for fill heights up to 2 m (6 ft), 3H:1V for heights of 2 to 3 m (6 to 10 ft), and 2H:1V for fill heights over 3 m (10 ft). Unless otherwise approved by the COB, in no case show earth slopes steeper than 2H:1V.

(3) The Construction Limit Line (CLL) denotes the limits of clearing and grubbing and extent of disturbed area (usually 3 m (10 ft) beyond top of back slope of cut or toe of fill slope).

(4) At least one T.B.M. convenient to the construction area must be shown and described on each sheet of the Grading, Paving, and Storm Drainage Plan. Indicate the finished floor elevation of all new building(s) and provide finish grade spot elevations at building corners, along sidewalks, edges of paved areas, etc., to assure positive surface drainage away from the structures and to prevent ponding.

(5) Differentiate clearly between new and existing contours, per directed or accepted CADD standards. New contour lines are to be heavy and tie into the appropriate existing contours. Existing contours over earth and paved areas are properly drafted free hand or electronically (CADD). Top of new pavements (T.P.), finished earth grades (F.G.), top of new curb grade (T.C.), etc., must be shown at all strategic grading points such as storm drain inlets, grade breaks, pavement corners, at P.C. or P.T. of pavement radii, along sidewalks, and at all points necessary to establish the new grading pattern.

(6) Channelized storm water runoff over sidewalks must be avoided by providing diversions, inlets, or cross drainpipe to intercept the runoff. Do not permit transverse runoff originating from extensive earth areas to paved parking areas at any time. Intercepted such runoff before reaching the pavement.

(7) Maximum acceptable longitudinal grade on sidewalks is 12%, but avoid grades steeper than 10% wherever possible. Make transverse grades between 2% (1/4 in/ft) and 4% (1/2 in/ft). Where steps are required in sidewalks and 8 or more risers are required, split the steps into separate groups with landings between. When sidewalks also serve as driveways, increase the minimum thickness accordingly or add reinforcing steel to support the anticipated vehicle wheel loadings.

(8) Indicate radii at roadway and street intersections and turnouts dimensioned to back of curb, unless noted otherwise. Indicate existing spot grade elevations at intersections of existing and new pavements to assure construction of smooth tie-ins.

(9) Where the grading layout extends over more than one sheet, use neat match lines to indicate breaks in topography. Overlaps, overruns, or repetitions in the layout are not permitted.

(10) Visit the site during the design period to assure that new and existing grading, paving, and storm drainage work are properly coordinated with other design disciplines, as referenced earlier. During the site inspection, determine the feasibility of preserving existing trees and

the natural terrain's compatibility with other site grading requirements and landscaping, when required.

(11) Grading and Surface Drainage.

(a) Design site grading to avoid/reduce erosion where possible, yet assure protection of buildings and pavements by providing controlled runoff of surface water. Implement best management features to retard storm water runoff (inlet swales, depressions, basins, etc.) runoff in the design. Slope finished earth grass adjacent to buildings and pavements away from the immediate area at a rate of at least 2 percent. Site conditions and facility requirements govern exact site grading requirements in open areas, but use graded earth slopes not less than 1 percent before channelization occurs, except for special occasions. Avoid steep earth grades around splash blocks and riprap of storm drain outlets at all items to prevent soil erosion. Large open graded areas and extensive back slopes may require further protection with interceptor and diversion terraces, ditches and inlets.

(b) Minimum grading for roadway pavement transverse slopes is 2 percent (1/4 in/ft), except at transition points with intersecting roadways where the slopes must vary as a function of the roadway design grade(s).

(c) Parking Areas. Hold surface grades in parking areas to the minimum required for drainage, but not less than 1 percent, measured perpendicular to the finished grade contour. For safety reasons, maximum cross slope grades for parking areas designed for 90-degree parking are 8 percent along the aisles through the area and 1-1/2 percent for the transverse slope. For parking areas designed for 60 degree and 45 degree parking, the maximum cross slope grades are 5 percent along the aisles through the area and 1 percent for the transverse slope. Use combination curb and gutter around all vehicle parking area(s) and also along approach drives to control surface drainage, provide vehicle barriers and present a neat appearance. Slope the curb and gutter a minimum of 0.30 percent to prevent ponding and assure positive drainage to curb inlets. Light fixtures require concrete to prevent vehicle damage to the light poles.

(d) Locate the new storm drainage system using the symbols included in the legend and indicate the direction of pipe and surface flow. Identify drainage structure with number designations corresponding to same used in the storm drainage design analysis and the pipe and structure schedule included in the drawings details. Major drainage ditches or channel relocations may require cross sections.

(12) Paving. The above paragraphs specify the basic grading requirements. For vehicle roads and parking areas, design flexible and rigid pavement IAW procedures specified in TM 5- 822-5. Design both rigid and flexible airfield paving IAW revised design curves furnished with the applicable airfield design TM/AFM.

(13) Pavement Markings. Parking stripes in parking areas. Traffic arrows and other markings follow requirements in the "Manual of Uniform Traffic Control Devices," published by the Federal Highway Administration of the U .S. Department of Transportation and/or the State Transportation Agency.

(14) Grassing and Turf Establishment. Specify all newly graded earth areas, slopes, ditches, and other disturbed areas be grassed. Specify a temporary winter cover crop in the event the finish grading is anticipated to be completed during seasons unfavorable to establishment of permanent grasses.

5.5.7 Miscellaneous Site Work Details: Include the following, when applicable:

- a. Standard Details. Typical pavement section(s); curb and gutter and surface inlet(s); manhole frame(s) and cover(s); grate cover(s); headwalls; and sidewalks, as required. Generally, where concrete curb and gutter is used to control surface drainage, curb and gutter inlets are used to intercept runoff from vehicular pavements. Use grate or weir type inlets only in turfed areas, but only grated inlets in aircraft pavements.
- b. Minimum pavement thickness and depth of compaction requirements, same as shown in the pavement design analysis.
- c. A concrete joint layout plan and joint details vehicle hardstands and aircraft parking areas showing the location, type of joint, and dimensions between joints; joint details conforming to the applicable standard drawing details; and joint Layout Plan for all rigid concrete pavements (unless instructed otherwise by the COE).
- d. Sidewalk width, and length of joint layout, with Installation Notes to construction contractor.
- e. Storm Drain Pipe Profiles for concrete, clay, PVC, HDPE, ductile iron, or corrugated metal pipe showing existing ground line, finished grades, drainage structures, invert elevations, pipe slope, sizes, and lengths, intersecting sanitary sewers, water lines and other underground utilities crossing the storm drain line on the profile(s) at their proper elevation; adjusted pipes that conflict at crossings, adequately detailed; a "Storm Drainage Pipe and Structure Schedule" including the appropriate construction notes.
- f. Dimensions of vehicle parking spaces, including parking for the physically disabled when required.
- g. Chain link fence, when required for general security, normally at a height of 2100 mm (7 ft), plus barbed wire top (Type FE-6).
- h. Special Details.
 - (1) For projects with extensive road and street systems include longitudinal profile grades showing approximate existing ground line, P.C., P.I., and P.T.'s, gradients, intersecting drain pipes, and new top of pavement grade elevations. At intersections where pavement grades must be warped for proper drainage, a 1:100 (1' = 10") scale detail with contours drawn at 30 mm or 60 mm (0.10 ft or 0.20 ft) intervals (depending on steepness and grades).
 - (2) At least one typical/ site section through the building and paved and graded area-s to illustrate the relationship of the finished floor elevation of the building(s) to the graded and paved slopes on the project site.
 - (3) Erosion control measures shall be as specified:
 - (a) Consider long term erosion control measures as part of the final site design. Measures include: grading with the proper percent of slope to distance; any areas not paved being established with permanent grass; reducing the extent of grading to leave existing plants; installing ground covers(s) and woody plants that will resist erosion; terracing, diversion channels, water bars, and ditching. Riprap, paved ditches, ditch checks, retention ponds, etc. may be used, if erosion cannot be controlled as described by the above items.
 - (b) Short-term measure to be considered during the construction period of the contract include, but are not limited to: phasing soil exposure areas and time of year; reducing the period of exposure by planting or paving quickly; using straw/hay bale barriers/silt fences; mulches;

matting; and settling ponds. Show recommended locations of temporary control measures on the Grading Plan.

(4) Details from State DOT Standard Drawings if used.

5.5.8 Plan and Profile Sheets shall be prepared and submitted in conformance with requirements stated in Technical Manuals the State Commonwealth Governing Authority.

a. For a recreation area road complex or range trail design, show the construction centerline (C/L), right-of-way limits, and all important topographical features such as fences, buildings, stream and railroad crossings, etc. on the plan view.

(1) For construction contractor's information, locate or reference monuments and benchmarks (BM's) with both horizontal and vertical control to expedite construction layout operations.

(2) Provide complete survey information necessary for establishing and stationing the proposed roadway C/L including: computed bearings of all tangents; coordinates of all points of tangent intersection (P.I.'s), and other curve data (I, E, L, etc.), for all horizontal curves in the proposed road alignment.

(3) Superelevation and widening details of roads, when required. When superelevation is required, include on the drawings a diagrammatic profile of how the superelevation is obtained; a table of shoulder slope(s) vs. cross slope(s) for the superelevated section; or, reference standard figures or tables included on the drawings.

(4) Note on the plan view the type and size of all "existing" drainage structure and the manner in which they are to be removed, utilized or otherwise affected by "New" work. Also, indicate locations of "new" cross drains, including inlet and outlet channels when required.

b. Plot the "proposed" C/L on the profile portion of the sheet at the same horizontal scale as the plan view. (Normally, use a vertical scale of 1:50 (1"= 5'), or as appropriate to fit the site terrain). Indicate the "existing" ground line at each centerline station on the profile, including both banks and channel bottom of stream crossings.

(1) Provide C/L grade elevations at each 20 m station on tangents and each 10 m station in vertical curves.

(2) Indicate the degree (percent) and length of all vertical curves. Include layout data (V, PVC, PVT, etc.) for each curve.

(3) Indicate the percentage/degree of slope for all proposed grade lines and provide elevations at points where grade changes occur. Provide special information pertaining to the profile and affecting the design, such as: curb grades, gutter grades, channel invert and top elevations of bridges, etc.

(4) Show correct locations and invert and top elevation(s) of both new and existing storm drainage structures on each profile. Indicate size and length of each structure.

5.5.9 Landscape Plan.

a. Expand the 30% Design by developing an overall planting layout. Furnish the Landscape Architect with information indicating the proposed location of all exterior utilities before beginning Landscaping design. Indicate on the 60% Design drawings and all subsequent plans both existing and proposed building, paved areas, signs, light standards, transformers, dumpster pads, storm drainage lines, and

other utilities and structures. Use foundation plants, shrubs, and ground covers to create a desirable setting, and to screen objectionable areas, but not to control traffic and other similar uses. Show all foundation planting(s) at a scale of 1:200 (1' = 20') but not smaller, and indicate the location of doors and windows, and any other feature of the building influencing the landscaping design. Include enlarged detailed plans of specific areas as needed to clarify requirements. Show common plant name, exterior utilities, north arrow, legend, and scale.

b. The Landscape Plan is an integral part of the planning and construction of the proposed project. In selecting plants, give attention to maintenance, hardiness, ultimate effect and grouping. Make the planting design informal, simple and composed of plants native to the area, with emphasis on trees. Show shade trees, evergreen trees, flowering trees, shrub masses, etc., according to designated functional and visual locations of plantings. Use a scale for the tree planting plan of 1:300 (1" = 30') or larger but not smaller for 1 through 4 buildings, 1:500 (1" = 50') or larger but not smaller for 5 or more buildings. This plan need not indicate wall openings. Include a plant list indicating the sizes of plants recommended for each of the above categories. Indicate each plant as a mature plant by one size and type symbol throughout the project design. Ground cover(s) may be indicated as a mass showing the area to be covered. On the plan, the key symbol for each plant type follows the quantity in a location or grouping; i.e., 4-50 mm (2 in) or 100 mm (4 in)-Q.

c. Include the 60% Landscape Plan with the 60% Design submittal. (If "existing" and "finished" contour elevations are considered critical to the landscaping layout, provide an overlay of the landscaping drawing(s) showing both the "existing" and "finished" grades and elevations). Show grassing limits or notes on Landscaping Plan(s) or on both the Grading Plan and the Landscaping Plan. Unless otherwise directed, always consider the following additional items:

- (1) Remove existing trees only if absolutely necessary for construction or due to disease/rot.
- (2) Specify plant materials that are hardy and require minimum care/upkeep to reduce overall maintenance costs of the new facility.
- (3) The planting design should reduce noise and glare, modify wind and temperature, control dust and erosion, and be compatible with the proposed exterior lighting plan of the project site. Avoid plantings that block aerial Street lights nor exhaust vents of building ventilation and air conditioning systems.
- (4) Locate plants so as not to interfere with underground utility lines. Accordingly, locate major and minor trees no closer than 1.5 m (25 ft) and shrubs no closer than 1.5 m (5 ft) from sanitary sewer lines.
- (5) Avoid plants interfering with safe sight lines of either pedestrians or drivers at Street, and road and driveway intentions.

d. Coordination. Coordinate landscaping plans with "existing" site conditions and the Removal, Layout, Grading, Paving & Storm Drainage Plans; architectural floor plans and elevations; and pertinent aspects of utilities (mechanical, plumbing, and electrical) drawings for proper location of items such as air compressors, fuel oil tanks, electrical transformers, meters, light standards, hose bibs and fire plugs. Coordinate COE and Using Activity (DPW/BCE) requirements before beginning 60% Design. Contact the Using Activity to substantiate the extent of design requirements and provide planting proposals which correspond with available maintenance capabilities.

5.6 60% Outline/Draft Project Specifications.

5.6.1. If not approved in the 30% Design review, include a list of CEGS applicable to Site Development of the proposed project with a brief description of deviations or omissions.

5.6.2. If approved in the 30% Design review, submit the draft project specifications.

5.7 Additional Information.

List any additional information or design criteria that has not been furnished to date that A-E design considers necessary to prepare a complete final design submittal and bidding documents.

6.0 FINAL (90%) DESIGN SUBMITTAL REQUIREMENTS.

6.1. General: Advance the project design to completion, complying with/incorporating approved comments received from review of the 30%/60% Design Submittal. Submit the final as if it is "Ready to Advertise" (RTA) when received.

6.2. Specific: Whenever the final design is based on a approved 30% Design Submittal, refer to paragraph, "60% Design Submittal Requirements" for guidance in preparing a complete design, including developing a detailed storm drainage and pavement design analysis final drawings, draft project specifications, and final site work quantities.

6.3 Final Design Analysis: Update/revise previously prepared analyses to support final plans and specifications, as noted above, including both original and revised dates of preparation, when applicable, and the names of preparer and checker.

6.3.1 Storm Drainage Design: If an acceptable storm drainage design analysis was furnished with the 30% or 60% design submittal, no additional analysis will be required. However, when revisions are required, the A-E must resubmit the analysis, same as for the storm drainage design, as noted above.

6.3.2 Pavement Design: If an acceptable pavement design analysis was furnished with the 30% or 60% design submittal, no additional analysis will be required. However, when revisions are required, the A-E must resubmit the analysis, same as for the storm drainage, as noted above.

6.3.3 Landscaping & Design: When required the design contract, landscaping design consists of preparing "complete" landscape studies, drawings, and specifications. Base the design on all general and specific criteria (standard drawings, manuals, etc).

6.4 Final Design Drawings.

6.4.1 Base portion of final site plan drawings on revising the 30% or 60% Design drawings. Develop Site Plan drawings with sufficient information to permit proper layout and construction. Prepare the final drawings uncluttered, neatly drawn and lettered, and capable of assuring clarity at half-size reproduction. All drawings not neatly rendered and not considered capable of clear half-size reproduction will be returned to the A-E for redrafting. The final drawings include all pertinent details such as typical pavement sections, storm drainage inlets and manholes, curb and gutter sections, etc. They may be modified by the A-E when necessary to conform to specific field conditions.

a. Add appropriate, General Notes to drawings, as required.

b. Insure correct cross referencing between site plan drawings for appropriate details, sections, match lines, other design disciplines, etc.

c. Eliminate any possible conflicts (horizontal and vertical) between site development and architectural, structural, and utilities drawings by coordinating with other design disciplines.

6.4.2 Final Site Development drawings include a drawing indicating the location and type of all soil borings, identifying each in the legend. Coordinate with geotechnical engineer (generally, the Site Grading Plan is preferred for this purpose).

6.4.3 Final Landscape Drawings indicate proposed plants by a (+) mark for the plant location and a circle scaled at approximately 2/3 the ultimate canopy growth spread (diameter) of trees and shrubs. Also, include a "complete" schedule or plant list of materials listing both botanical and common name(s), plan symbols, quantities, sizes and condition furnished. Final drawings also include the basic detail sketches for installation of tree, shrub and ground cover plantings, plus any other applicable details for clarification of specific project requirements. Include pertinent notes, applicable to construction requirements, in addition to standard notes. The final landscape plan, plant schedule, details, notes, specifications, and cost estimate must agree.

6.5 Final Project Specifications.

6.5.1. Before beginning preparation of specifications, refer to the latest Modmaster/CEGS covering all items of anticipated site work. These Modmaster/CEGS may have been revised or updated during the period between A-E first commencing project design and beginning preparation of the draft project specification.

6.5.2. Insure consistency of terminology between drawings and specifications for specific items of work by appropriate notations on drawings.

6.5.3. Check to insure adequate referencing to standard detail sketches included in the Site Details for construction. Details for Site Development are never included in the specifications, only on the drawings.

6.5.4. Base landscape specifications upon the current Guide Specification "Trees, Shrubs, Ground Covers, and Vines", edited for specific project requirements.

6.5.5. Submit specifications covering all proposed items of site development.

7.0 CORRECTED FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS.

The 100% design submittal is not considered to be a formal design/review submittal, but will be required in those cases in which the final approved comments indicate revision(s) to correct design error(s) or omission(s) in the final design submittal.

7.1 100% Design Analysis: Revise the D.A. to support the corrected requirements for paving, storm drainage and protective berm designs for the project, by incorporating approved comments received from the Final Design Submittal.

7.2 100% Design Drawings: Revise thoroughly checked drawings, same as above for the design analysis.

7.3 100% Project Specifications and Site Work Quantities. Same as above for design analysis and drawings.

8.0 MISCELLANEOUS DESIGN REQUIREMENTS FOR SITE DEVELOPMENT

8.1 Engineering Manuals. Request the District to furnish the source for latest editions of the applicable design manuals.

8.2 Fill, Borrow, or Waste Materials. Whenever possible, develop site grading to achieve a balance of cut and fill in computing earthwork quantities. Make suitable allowance for shrinkage of fill quantities due to compaction effort required. When estimating quantity of excavation necessary for the earthfill, the embankment (fill) should be increased by approximately 25 to 35 percent for cohesion less soils (sands) and 25 percent for cohesive soils, unless otherwise instructed.

8.2.1. For Projects Located on Military Reservations or Other U.S. Government Property. Determine whether earth borrow or disposal of surplus earthfill and other waste material will be required, and the quantity of material involved. Write the grading specification(s) indicate whether earthfill borrow or disposal of waste material will occur on the military reservation. Coordinate borrow and waste disposal areas with the PE/A to determine the location and limits of borrow areas containing suitable soils, disposal areas, and permissible haul routes through the installation. (The designated haul route(s) may not always be the most direct route).

8.2.2. Unsuitable Soils. Specify removal of all unsuitable soils (trash, organic soils, and highly plastic clay soils) determined by site inspection(s) and boring logs, from areas within the limits construction for both the building(s) and paved areas. Remove unsuitable soils and dispose as described above. Determine and specify on the drawings the depth and limits of unsuitable soils to be removed. For determination and guidance in selecting the limits of removal, plot the boring log on the appropriate work cross section(s) or profile(s). To guide the construction contractor in removal operations, show the limits and extent of the removals by appropriate symbol(s) or notes on the finished profile(s) and cross section(s) in the final contract drawings.

8.3 Disposal of Existing Pavements, Foundations, Floors, etc. Specify that all pavements removed, including floor slabs, footings and chimneys, be broken into pieces measuring not more than 300 mm (12 in) on anyone side. If approved, the broken pieces may be used as grouted riprap for ditch pavement to eliminate erosion. Material not used for this purpose may be placed in a 300 mm (12 in) layer, uniformly tamped and leveled to present a satisfactory appearance on outfall ditch bottoms and side slopes in outlying areas. When ditch pavement or side slope protection is not required, place material in the disposal area shown on the Location Plan.

8.4 Special Instructions for Designing a Large Building Complex, Major Road Network or Airfield Pavements. When a project design consists of a large complex of buildings, major road network, or airfield pavement, the following additional instructions are applicable;

8.4.1. In addition to general layout by dimensions from existing structures, key points must be referenced to a construction base line (B/L) tied into the installation's plane coordinate system. Unless otherwise specified, reference the plane coordinate system to local datum(s) established for the particular project, using the monuments of the B/L and other features such as C/L points of the existing road, etc., for the construction contractor to re-establish control points in the field and to lay out the new construction work.

8.4.2. For a large building complex show finished grade contours.

8.4.3. Unless otherwise instructed, where existing roadway pavement is specified to have overlay pavement, cross section elevations must be taken at station intervals not greater than 15 m (50 ft) along the C/L and also the edges of the pavement to establish the minimum and maximum depth of overlay pavement required and the finished profile grade(s). Located and indicated all "existing" potholes and badly cracked pavement sections. Include details for patching and repair. Road profiles may be plotted at a scale of 1:500 (1"= 50') horizontal and 1:50 or 1:100 (1"= 5' or 10') vertical. (The vertical dimension scale will be determined by the complexity of the existing topography). Other scales may be considered, with prior approval of the District.

8.4.5. Plan and profile wings are required for all extensive "major" road designs, including family housing, recreation areas, and range complexes. The plan view includes topography taken along the C/L of the proposed road and extending to either side a minimum of 15 m (5ft) beyond the end of the estimated cut or fill slopes. Topography of intersection drainage swales and ditches must be carried a sufficient distance (not less than 60 m (200 ft) from C/L of road) to show transition to/from the proposed culvert headwall, graded swales or roadside ditches. The scale of drawings for major road designs may be, 1:500 (1" = 50'), and must show existing contours on which the new road is to be placed. Finished grade contours are not required on roadway projects except at road intersections and turnouts, at major buildings, or around major drainage structures. Include roadway cross sections in the contract drawings and may serve in lieu of finished grade contours. However, if a roadway under design is short length, upon approval, the A-E may use finished grade contours in lieu of including finish cross sections in the final contract drawings. In such cases, furnish working

cross sections to support calculations of total earthwork quantities and for determining balance points of cut and fill.

8.4.6. When preparing cross section drawings for a large building complex and major road network, include the plotted end areas, sum of end areas, quantity of earthwork between full stations or plus stations and the subtotals at the top of each sheet. (Plot cross section stationing from the bottom toward the top of the sheet). Indicate stripping and removal of unsuitable soils the computed volume of excavation. To simplify establishing the limits of unsuitable material(s) to be excavated, the boring logs may be plotted on either the work cross sections or the C/L profile(s) in addition to the boring log sheets. Provide on the final cross section sheet(s) a tabulation of the total embankment, excavation, stripping, and when required, the excavation of unsuitable soils. Apply a suitable shrinkage factor for compaction to the embankment quantity for each individual section or to the total fill quantity, depending on whether or not balance points are being considered along the C/L profile to determine if borrow or waste is required. When portions of the stripped material can be processed and reused as topsoil, the final estimated earthwork quantities shall reflect this volume of soil used. The shrinkage factor swelling the embankment areas shall be carefully selected to be representative of the type and density of the soils anticipated to be encountered, and the degree of compaction to be specified.

8.4.7. Prepare cross sections for airfield pavements in final form and include in the final contract drawings preparation of these cross sections is specified in the preceding paragraphs, with the additional requirement of showing the boring logs located at the appropriate section(s). This will simplify the review of existing soil(s) upon which the pavements will be constructed, and readily determine the acceptability of the site soils and the extent of removal and replacement of unsatisfactory soils, if required.

8.4.8. The need for reasonably accurate earthwork quantities cannot be overemphasized. The A-E must inspect the site of the work and take into account the type of terrain (woods, swamp, pasture, cultivated) and soils, since all these items have a bearing in making assumptions and applying the proper factors in estimating the total quantities of earthwork for the project.

- (1) Stripping of topsoil, roots, etc., (indicate depth and limits).
- (2) Removal of organic or other unsuitable soil (indicate depth and limits).
- (3) Earth fill (embankments), including the appropriate shrinkage factor applied to embankment earthfill to compensate for compaction.
- (4) Allowance of over-building as a result of subsistence of high fills (indicate depth).
- (5) Allowance or backfilling of stump holes, if significant.
- (6) Usable soil(s) available for earthfill from the general excavations on the project site.
- (7) Location of earth borrow area(s), when sufficient material for earthfill is not available from the general excavations on the project site.

8.4.9. Judicial use of gravel areas should be considered for use around any buildings where the gravel can be used to break items such as windows and globe type light fixtures.

8.5 Landscaping.

8.5.1. General.

- (1) When landscaping is required in the project design, make field investigation(s) to determine the location and type of existing plants and trees, verify location of sidewalks, drives and parking areas, aerial and underground utilities, and other information including user requests, deemed necessary for complete design of the project. Give specific attention to

emphasizing building entrances, screening of utilities, and erosion control, as required by site characteristics.

(2) The final landscape design shall reflect incorporation of all approved review comments, Using Activity requests and/or recommendations resulting from review of all previous A-E design submittals.

(3) The items included for landscaping design require a complete set of drawings IAW with the applicable TM's. If available, also use the Installation Design Guide.

(4) Develop contract specifications primarily from Guide Specification Section entitled "Planting of Trees, Shrubs, Ground Covers and Vines".

8.5.2. Specific.

(1) Include the following additional information in the landscape plan:

- (a) Existing plantings (to scale as near as possible).
- (b) Key Plan (not to scale).
- (c) Detailed Final Cost Estimate shall include Final Landscaping Quantities.
- (d) Plant List or Schedule, giving botanical and common names, size, caliper trees only), manner grown and prepared, and quantity.
- (e) Graphic or bar scale.

(2) For projects having two or more buildings, the A-E may:

- (a) Submit a 60% Design containing complete tree planting and foundation plan(s) for each different building footprint, IAW subparagraph (2) above, and other applicable requirements.

(3) Include in the final landscape design all landscape documents required by the contract and reflect corporation of all previous design approved comments and instructions returned to the A-E through the Norfolk District.

8.6 Sediment Erosion Control.

8.6.1. Consider long-term sediment and erosion control measures as part of the final site design. Measures include: grading with the proper percent of slope to distance; any areas not paved being established with permanent grass; reducing the extent of grading to leave existing plant standing; installing ground cover(s) and woody plants that will resist erosion; terracing, diversion channels, water bars, and ditching. Riprap, paved ditches, ditch checks, retention ponds, etc. may be used, if erosion cannot be controlled as described by the above items.

8.6.2. Short-term measures to be considered during the construction period of the contract include, but are not limited to: phasing soil exposure areas and time of year; reducing the period of exposure by planting or paving quickly; using straw/hay bale barriers/silt fences; mulch; matting; and settling ponds. Show recommended locations of temporary control measures on the Grading Plan.

----END OF CHAPTER----

CHAPTER 5

CIVIL/SANITARY ENGINEERING

1.0 GENERAL. This chapter presents minimum requirements and criteria for preparation of plans, specifications, and design analysis for water and wastewater systems.

1.1 Water Systems. Water systems include sources, pumping, treatment, storage, and distribution of water used for domestic, disinfection by-products, industrial, irrigation, and fire protection.

1.2 Wastewater Systems. Wastewater systems include collection, pumping, treatment, and disposal of domestic, disinfection by products, storm water, and industrial wastes.

2.0 CONCEPT/PROJECT DEFINITION (30%) SUBMITTAL REQUIREMENT.

2.1 Studies. Certain projects may be of such magnitude or significance that in order to select the best possible design the COE may require a study to be made before 30% submittal. Where a 10% submittal is specifically called for, submit the project site plan with the building outline and supporting utilities shown.

2.2 Study Plan Submittal. The plan shows the design approach in sufficient detail so that an evaluation by COE and Using Activity together with the A-E may arrive at the most feasible concept to prepare a 30% package. Submit on full size drawing sheets.

2.2.1 Building Service. For exterior building water service lines show flow, velocity and pressure drop between the water main and building, and pipe sizes. No design analysis of gravity houses sewers will be required unless the sewage flow exceeds the capacity of a 150 mm (6 in) pipe on a 0.6% slope. A design analysis is required for pneumatic ejector, building sewer pumps, grinder pumps, and hydropneumatic systems.

2.2.2 Water Distribution Main. If new water distribution mains are required, a Hardy Cross analysis may be required. This consists of a flow analysis of the proposed new mains, using fire demands developed from criteria contained in MIL-HDBK-1008C (or latest issue at the time of design effort). The flow around all loops is balanced by use of the Hardy Cross system of analysis or other approved means. In developed areas where the existing distribution mains appear adequate, indicate the required fire demand and verify the adequacy of the existing system by a fire-flow test at a nearby hydrant or by a partial flow analysis selecting the required number of mains to provide the fire demand. Include result of the fire flow test in the D.A. Also include frictional losses from test point to the site tie-on. If the existing systems are proved to be inadequate to supply the fire demand, then augment the system. Document this even though it may not be part of the project. Forward requirements for flow tests through the PE/A. Design fire pumping stations using individuals experienced in fire protection systems. Determine by 30% Design stage where fire pump station/ground storage reservoirs are required for specific projects.

2.2.3 Sewage. Gravity sewage collection system will be sized for 30% Design. Indicate sewage flows, velocities, pipe sizes, elevations, and pipe capacities. Where new sewage collection systems are to be connected to the existing system, check the master plans and existing collection system downstream for five or more existing manholes to see if it is adequate for the added flows. Provide design analysis for sewage lift stations and force mains, showing flows, velocities, components capacities, head requirements, detention periods, etc. Include design analysis for septic tanks and tile fields. Determine the feasibility of a septic tank and tile absorption field where buildings are remotely located and it is uneconomical to make normal house

connections into an existing main. Soil percolation tests will be conducted by the COE, or the state or local health department unless otherwise specified to be made by the A-E. Design oil/water separators IAW American Petroleum Institute (API) criteria to be capable of removing free and effluent oil globules equal to and greater than 20 micros and provide no greater than 10 mg/L free oil concentration effluent.

3.0 CONCEPT/PROJECT DEFINITION (30%) DESIGN DRAWINGS.

3.1 Exterior Utility Layouts. Show the exterior utility layout with adequate detail to show the various existing and new system sizes and materials of construction. Show points of connection.

3.2 Other Requirements. Any information other than the requirements listed above which the engineer considered necessary to show the intent of design.

4.0 PRELIMINARY (60%) SUBMITTAL REQUIREMENTS.

4.1 Design Analysis. Include all items in the 30% Design Analysis and any necessary revisions. In addition, include the following specific items, when applicable.

4.1.1 Water Supply Source. Provide the following:

- a. Calculations indicating available supply and pressure versus required supply and pressure if revisions are required.
- b. Calculations to support selection of all equipment and pipe sizes.
- c. Outline specifications.

4.1.2 Domestic and Industrial Wastewater Treatment.

- a. Average and peak loadings for individual unit processes including hydraulic gradient, biological and physical, etc.
- b. Detailed descriptions of proposed unit processes including type, size, capacity, supporting data, and calculations showing the degree of treatment expected in each unit process, as well as the overall treatment efficiency.
- c. Discussion of controls, instrumentations, and proposed operating sequences or methods.
- d. Discussion of features for operator safety and comfort.
- e. Discussion of facility layout from the standpoint of easy operation and maintenance.
- f. Calculations to support selection of all equipment and pipe sizes.
- g. Discussion of pollution control authority requirements and design compliance with authority requirements.
- h. Discussion of disinfection by-product(s) treatment and disposal.

- i. Outline specifications.

4.1.3 Domestic and Industrial Water and Wastewater Treatment Collection Systems.

- a. Detailed hydraulic calculations for each system including the worst fire situation for the water distribution system.
- b. Discussion of pipe materials and justification for the materials selected when different from the options listed in the CEGS.
- c. Outline specifications.

5.0 FINAL (90%) SUBMITTAL REQUIREMENTS.

5.1 Final Design Analysis.

5.1.1 General. Final design analysis is a refinement of 30% and/or 60% Design Analysis. Revise the previous Design Analysis as required to reflect changes made during final design.

5.1.2 References. Show applicable references for design assumptions not found in common reference manuals which were not listed during the previous design analysis.

5.1.3 Comments. Reflect all approved comments on the previous design analysis.

5.1.4 Computations. Include all pipe sizing computations in the D.A. Piping analysis must show design flow, pipe size, friction factors, slopes, lengths, and elevations where applicable, flow quantity, and velocity in the various main and branches. Where necessary, include flow diagrams in the analysis.

5.1.5 Pump Data. Determining pump heads based on complete take off friction losses and static heads. Systems heads curves are required for all pumping systems.

5.2 Final Design Drawings.

5.2.1 General. Final plans are a refinement and completion of the 30% and 60% drawings. Incorporate all approved comments relating to 30% or 60% Design stages in the final drawings.

5.2.2. Requirements. Where crowded conditions exist due to close proximity of other phases of the work, show sufficient sections and elevations to locate particular items in relation to other items.

- a. The number of elevations and details must be sufficient to allow construction and installation of the work, show sufficient sections and elevations to locate particular items in relation to other items.
- b. Where equipment connection details are shown, indicate all required valves, trim, gauges, and fittings required. Coordinate with specification requirements and make sure that valves, fittings, etc., that are specified to be furnished with each piece of equipment are included in the detail.

- c. Show all pipe sizes, catwalks, ladders, platforms, access panels, and doors required for operation and maintenance of equipment, valves, and accessories.
- d. Place performance characteristics for all items of equipment in carefully prepared equipment schedules. Equipment characteristics specified in "Note" fashion, or in random locations on the drawings are not acceptable. Select equipment characteristics which are not restrictive to any one manufacturer but competitive among at least three major manufacturers.
- e. Include electrical characteristics, classifications of National Electrical Manufacturers Associates (NEMA) type, if applicable, and except in special cases, rotative speeds, in equipment schedules.
- f. Coordinate locations of equipment and piping with architectural, pumping, mechanical, structural, electrical features of the project.
- g. Sanitary and industrial waste sewer drawings must have complete profiles for the entire length of run. Indicate existing and finished grades, and pertinent elevations, depth of bury, and interfering utilities which may be encountered. Indicate required utility separations.
- h. Provide complete construction details of water and sanitary sewer utilities, as well as layouts on final plans. Provide a legend on drawings to clearly differentiate between existing and new construction. Existing construction is generally indicated by light symbols and new construction is indicated by heavy symbol. Include existing construction data such as pipe size and materials, elevations, valve, and fire hydrant locations, etc. pertinent to new construction on the drawings.

5.3 Specifications.

5.3.1 General. Specifications shall not be restrictive. Generally, the description shall be such that at least three major manufacturers can meet the specified requirements. Do not use trade names in the specifications unless sole source authorization is requested and granted.

5.3.2 Coordination. Coordinate the subparagraphs on "Electrical Work" with the electrical section of the specification. There shall be no conflicts as to which section covers starters, control or cost estimated for all items such as lift stations, septic tanks, oil separators, etc. Show the top and invert elevations of all new and existing sanitary sewer lines and manholes on the plans.

6.0 CORRECTED FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS.

Incorporate all approved comments from the preceding reviews before the design is submitted as Ready-to-Advertise (RTA).

7.0 TECHNICAL REQUIREMENTS.

7.1 Permits.

7.1.1 Approvals. Construction of new facilities and major extension to existing water and wastewater systems must comply with the procedures requirements of the applicable state agency having approval authority. In most cases the Public Health Department for water supply and on-site wastewater treatment systems. Each state also has a department for pollution control projects involving point discharges. For this reason coordinate all designs of water and wastewater systems with the appropriate agency at all stages of design. For most

states, review and approval of the final plans and specifications constitute approval for construction. Issuance of a construction permit/license for pollution abatement projects is also a requirement in many states.

7.1.2 Application. Contact the appropriate state pollution control agency and verify the procedure to obtain a construction permit. In addition, where formal documents are required to be submitted, prepare all permits to a "ready for signature" condition. After review by the COE, forward the documents to the State. Determine permit requirements at the time of the 30% submittal.

7.2 Standard Systems Criteria.

7.2.1 Buildings Service.

a. Water Service Connection. Provide exterior water service connections to all new buildings from existing and/or new water distribution systems. Size building water service connections to meet the peak building demands as indicated in TM 5-810-5/AFM 32-1070, Chap. 4 and AFR 88-15 (Draft) for Air Force projects. Pressure drop between street mains and buildings must not exceed 226 Kpa/100 m (10psi/100 ft) at these rates of flow. Provide valve or curb stop with box near connections to main. If known, indicate materials to which new will be connected on the plans.

b. Building Sewers (Sanitary). House sewers are either gravity or force main as required by the building site conditions. Gravity type building sewers are preferable, and they are 150 mm (6 in) minimum size pipe on at least 0.6% slope. Where gravity sewage connections to street collection mains cannot be provided, provide pneumatic ejectors or sewage pumps. Base the selection of pumps or on the economy of initial installation. No design analysis of gravity building sewers is required, by size and slopes of these lines must be shown. Provide duplex units where ejectors or pumps are required. The capacity of each unit must be sufficient to handle the peak rates of flow. Operation of the pumps is "lead-lag" for single as well as combined capability.

7.2.2 Fire Protection.

a. Distribution Mains and Fire Hydrants. Provide distribution mains and fire hydrants, if not already existing in the building area, IAW the applicable portions of Army TM 88-10, Vol. 1 and TM 5-813-5/afm 88-10, Vol.5. The residual flow pressures at design flows shall not be less than 20 psi. When practical, design water mains parallel to streets and roads, but not under roadway pavements, if practical. The fire demand is determined by the sum of the fire flow, 50% of the average domestic demand rate, and any industrial demand that cannot be reduced during a fire period. See TM 5-813-1/AFM 88-10, Vol. 1 and AFR 88-15 (Draft) for Air Force projects. Provide fire hydrants where required. Each building should be within 90m (300 ft) of at least two hydrants. Show fire hydrant with gates valve on service lines. All dedicated fire flow lines shall be cathodically protected.

b. Building Sprinkler Supply Mains. Size sprinkler supply mains according to NFPA. The adequacy of the existing or proposed distribution system and sprinkler lines to meet the sprinkler and hose stream demands as indicated in MIL-HDBK-1008C (latest edition) is determined by a fire flow analysis or other approved means of analysis. Calculate the fire sprinkler demand flow and residual pressure can be provided by the available flow and residual pressure with the outside fire hydrant demand hydraulically deducted. If the available flow is greater than the required flow and residual pressure, the design is acceptable. If not, augment the existing distribution system to provide at least a 105 kPa (15 psi) residual pressure at the highest sprinkler heads in the building at the design fire demands. Provide cutoff valves with boxes on the supply mains. These are located not less than 7.5 m (25 ft) nor more than 15m (50ft) from the face of the building which they are to serve. They may be either the post indicator type or the rising stem and yoke type installed in a pit. Indicator valves are generally used in grassed areas, and rising stem and yoke type installed in underground pits in paved area. Fire pumping stations comply with MIL-HDBK-1008C (latest edition) and NFPA Codes 20, 24, and 409, as appropriate. Design these by persons experienced in design of the fire protection systems.

7.2.3 Sewage Collection System. Refer to appropriate/applicable state code for specific design requirements.

a. Gravity Mains. Where more than one building is involved, use gravity type sewage collection mains. Design is to conform to the applicable requirements of TM 5-814-1/AFM 88-11, Vol.1 and AFR 88-15 (Draft), Chap. 15, for Air Force projects. Size gravity sewers to discharge the expected peak rate flow. The minimum size of sewer mains (not house sewers) is 200mm (8 in). The sewers are usually laid with sufficient slope to provide a velocity of at least 0.6 m/s (2 fps) at the average daily flow or average hourly flow rate and a minimum velocity of at least 0.6 m/s (2 fps) at the average daily flow or average hourly flow rate and minimum velocity of 0.75 to 1.0 m/s (2.5 to 3.5 fps) at peak diurnal flow rate. See TM 5-814-1/AFM 88-11, Vol. 1 and AFR 88-15 (Draft), Chap. 15, for Air Force. Locate sewage collection mains by the topography of the site to keep excavation for these lines to a minimum.

b. Force Mains and Sewage Lift Stations. Where more than one building is involved, if gravity type sewers cannot be provided, design sewage pumps in a sewage lift station construction on the lowest terrain in the vicinity. As force mains do not require any specific grade for satisfactory operation, they shall be constructed as straight, short, and shallow as possible. In this section of the United States, they are generally installed 750 mm (30 in) below final grades but always below the frost line. Force mains and sewage lift stations conform to the applicable requirements of TM 5-814-1/AFM 88-11, Vol. 1 and AFR 88-15 (Draft), Chap. 15 for Air Force projects. Design sewage pumps to meet actual head conditions of the force main provided for the lift station. The design point on the pump characteristic curve is determined by plotting this curve against the system head-capacity curve. The system head-capacity curve is obtained by combining friction head, static head, and velocity head curves. Where pumps operate in parallel or series, provide combined curves. The intersection of characteristic curve with system head curve is the design point. Describe major items of equipment with sufficient clarity to permit a definite selection for cost estimating purposes from manufacturers' catalog data. Where appropriate, grinder-type pumps shall be considered.

c. Septic Tank and Tile Field Absorption (for remotely located facilities). Design septic tanks and tile fields IAW TM 5-814-3/AFM 88-11, Vol. 3; Manual of Septic Tank practice; and applicable state criteria. Specify prefabricated septic tanks where locally available in the required size.

d. Provide oil-water separators where required and designed IAW API criteria. Provide a grit chamber for installation upstream of the separator where grit is prevalent in the waste. Oil water separators shall be easily accessible for cleaning and maintenance purposes. Buried tank type oil water separators should be highly scrutinized and discouraged for use.

7.2.4 Treatment Plants. For water and wastewater treatment plans see specific instructions to the A-E contained in the design contract.

7.2.5 Seismic Provision. Include appropriate provision for protection of piping, equipment, and underground utilities against damage from seismic events IAW TM 5-809-10/AFM 88-13, Chap 13.

7.2.6 Fire Protection. For fire protection using AFFF systems comply with the requirements AFR 88-15 (DRAFT), Chap. 15. Provide a means for containing and disposing AFFF foam solution runoff.

8.0 SUPPLEMENTAL DESIGN CRITERIA.

8.1 Water Supply. Shall be developed and formulated in accordance with the Commonwealth of Virginia and supplemented with TM-813 series for projects located within Commonwealth of Virginia. For projects beyond the Commonwealth of Virginia, the appropriate local state regulatory standard for water supply shall apply.

8.1.1 Pumps. Vertical turbine pumps larger than Kw (5 hp) conform to AWWA E101-88.

8.1.2 Plants. Design of water treatment plants conforms to TM 5-813-3/AFM 88-10, Chap. 10 para. 8; applicable State Public Health Department criteria for public water supplies; Recommended Standards for Water Works (Ten States' Standards).

8.1.3 Small Systems. For small isolated facilities shall use a hydropneumatic pressure tank and, if appropriate, a ground storage reservoir. Small systems will normally be located in a protective building.

8.1.4 Piping. For supply and distribution piping comply with TM 5-813-4/AFM 88-10, Chap. 5, and AFR 88-15 (Draft) or governing state/local authority regulations. Base piping materials on CEGS-02660.

8.1.5 Storage. For water storage design comply with TM 5-813-4/AFM 88-10, Chap. 4, and AFR 88-15 (Draft) or governing state/local authority regulations.

8.1.6 Friction Losses. In computing head losses due to friction in a distribution system, use the Hazen-Williams formula.

8.1.7 Analysis. Hydraulic analyses are made using a value of $C = 100$ for the roughness coefficient, however, consider the use of coefficients greater than 100 when specifying concrete or plastic pipe. Coefficients greater than 130 should not be used. Do not specify asbestos-cement pipe.

8.1.8 Location. Locate water mains at least 3 m (10 ft) horizontally from sewers, drain lines and building foundations. When required, a minimum horizontal separation of 1.8 m (6 ft) can be allowed, but the bottom of the water main must be at least 300 mm (12 in) above the top of the sewer

8.1.9 Crossings.

- a. Where water mains must cross sewers, conform to the requirements in the state/local regulations.
- b. Water mains crossing railroads shall be installed in protective casings conforming to the requirements of American Railway Engineering Association (AREA), Vol. 1. Design should specify method of construction for each particular sit (open cut vs. jacking).
- c. Water mains located in airfield pavements shall conform to the requirements of TM 5-813-/AFM 88-10, Chap. 5.
- d. Water mains crossing through flow control structures or dams shall be encased in a steel sleeve.

8.1.10 Valves. Provide control valves on distribution systems IAW TM 5-813-5/AFM 88-10, Chap. 5.

8.1.11 Pressure Relief. Provide air release and vacuum relief valves IAW the requirements of TM 5-813-5/AFM 88-10, Chap. 5.

8.1.12 Fire Protection. Fire hydrant shall be provided IAW the requirements of TM 5-813-5/AFM 88-10, Vol. 5, Chap. 5 and NFPA 24, Outside Piping. Hydrants should not be located closer than 7.5 m (25 ft) to a building and not more than 2 m (7 ft) nor less than 1.8 m (6 ft) from the edge of the paved roadway surface. Residual pressure at fire hydrants should not be less than 140 kPa (20 psi) when flowing at the desired rate. Fire hydrant branches are not to be less than 150 mm (6 in) in diameter, are as short in length as possible, and have a gate valve.

8.1.13 Thrust Blocking. Use thrust blocking IAW TM 5-813-5/AFM 88-10, Vol.5, Append. C.

8.1.14 Fire Line Analysis.

- a. Where the base distribution system is unable to provide the quantity of water at the required residual pressure needed for the sprinkler systems and hose streams, analyze the system and provide pumping equipment and, if appropriate, ground storage. A complete design analysis is required, including fire flow test data. Pumping stations conform to the requirements of NFPA 20. Pumping stations for aircraft hangars conform to NFPA 409, except that fire pumps shall be diesel engine driven. Provide post-indicating cutoff valves IAW NFPA 24.

b. Water for domestic purposes and fire protection for special projects such as reserve centers conform to TM 813-7/AFM 88-10, Chap. 7.

8.1.15 Service Lines. Size service lines for new buildings to meet peak building demands IAW TM 5-810-5/AFM 32-1070 and/or AFR 88-15 (Draft) for AF. Pressure drop between street main and building should not exceed 226 kPa/100 m (10 psi/100 ft) at peak rate. Provide control valves as required.

8.1.16 Disinfection. Specify that all water mains, and storage tanks in the project shall be effectively sterilized with chlorine solution and tested bacteriologically safe IAW AWWA 651 (Disinfecting Water Mains) before placing them in service.

8.1.17 Cathodic Protection. Provide cathodic protection for storage reservoirs and for dedicated fire water supply lines.

8.2 Wastewater Treatment and Disposal.

8.2.1 On-site. On-site treatment disposal facilities to conform to applicable criteria published by the appropriate State Public Health Department.

8.2.2 Alternatives. Where on-site soil conditions are such that the septic tank and tile field system cannot be used, consider using of septic tank and subsurface filter system. A composting system may be considered. Design must conform to the above referenced documents for septic tanks.

8.2.3 Gravity Sewers.

a. Provide a minimum of 750 mm (30 in) of cover over pipe.

b. Manholes are required at the end of laterals and at each change of direction or slope.

c. Maximum distance between manholes is:

(1) Diameters less than 450 mm (18 in) 120 m (400 ft)

(2) Diameters 450 mm (18 in) and greater 180 m (600 ft)

d. Drop connection are required at manholes when invert of the inlet pipe is more than 450 mm (18 in) above the manhole floor.

e. Minimum size building sewer connection is 150 mm (6 in) diameter with at least 0.6% grade.

f. Design sewers with sufficient slope to ensure cleansing velocities.

g. Base flow capacity of building sewer connection, except for barracks, on fixture units. For barracks, flow capacity is based on actual contributing populations.

h. Minimum size sewer mains between manholes shall be 200 mm (8 in).

i. Use Manning's formula for computing gravity flow in sewer. Use $n = .014$ for pipe smaller than 250 mm (10 in) and $n = .013$ for pipe larger than 250 mm (10 in). When smooth wall thermoplastic piping is used a $n = 0.09$ factor may be used.

- j. Analyze deep sewers for excessive loads.
- k. When selection pipe materials consider structural loads, soil conditions, and characteristic of transported wastes.
- l. Design analyses are required for sizing all 200 mm (8 in) and larger sewers.

8.2.4 Pumping Stations.

- a. For force mains, analyze potential unbalanced thrust forces caused by water hammer conditions.
- b. Minimize force main size where non-clog pumps are used is 100mm (4 in). Smaller pipe sizes can be considered when grinder pumps are used.
- c. Small lift stations are wet-pit, submerged-pump type.
- d. Pumping capacity must be adequate to discharge the flow rates when the largest pump is cut of service. Design each pumping unit as constant speed type and capable of discharging the extreme peak wastewater flow rate. Specify alternate pumping between discharges.
- e. Overflows are not allowed.
- f. Complete design analysis is required.
- g. Provide force mains with a minimum 750 mm (30 in) of cover.
- h. Include system head curves for all pumping systems.

8.2.5 Wastewater Treatment. Wastewater treatment plant designs conform to TM 5-814-3/AFM 88-19, Vol. 3; AFR 88-15 (Draft); applicable "state criteria; and Recommended Standard for Sewage Works (Ten States' Standards) and state health department/environmental quality requirements and criteria. Base designs on meeting National Pollution Discharge Elimination System (NPDES) discharge limitations for the receiving stream.

8.2.6 Industrial. Base or military industrial facility treatment plant designs for industrial wastes on meeting NPDES discharge permit limitations of the receiving waters or stream.

8.2.7 Pretreatment. Pretreat wastewater containing oils before discharge. Use gravity oil-water separators of the pre-engineered type on aircraft washracks, bilge water collectors tactical equipment shops and industrial facilities before discharge to central sewage collection systems. Where central sewage systems are non-existent, package type readily accessible, oil-water separators meeting State discharge criteria are required. Grit separators are required to be located ahead of oil-water separators.

8.2.8 Washracks. Wastewater containing oils and large amounts of sediments generated from cleaning tactical vehicles at central vehicle wash facilities (CVWF's) shall be collected and treated IAW with criteria in TM 5-814-9 and Army ETL, Alternatives for Secondary Treatment at Central Vehicle Wash Facilities.

8.3 Solid Wastes. Design landfills conforming to TM 5-814-5 for Army for AFR 88-15 (Draft) for Air Force and applicable state and USEPA criteria. Landfills shall be designated for characterized and classified solid waste.

----END OF CHAPTER---

CHAPTER 6

ARCHITECTURAL

1.0 GENERAL

This chapter states criteria, requirements and guidance for architectural design.

1.1 Architectural Quality

The objective of the COE is to obtain attractive structures which are designed using sound technical knowledge and which are constructed using recognized, good industry practices, as well as being cost effective. The design and construction shall incorporate those characteristics which will provide structures with present and continuing utility, durability and desirability, and which will be economical to maintain for the life of the structure. The design shall also provide a safe and healthy environment.

1.2 Energy Conservation Study

Economic studies to evaluate the use of passive solar design techniques (building orientation, amount and location of windows, etc.) will be in accordance with Chapter 15, Energy Analysis And Economic Analysis, Control Systems, EMCS Studies.

2.0. APPLICABLE PUBLICATIONS

The following publications form a part of this Manual to the extent indicated by the references thereto:

2.1 Design References.

ADAAG	Americans with Disabilities Accessibility Guidelines, latest edition
AEI	Architectural and Engineering Instructions, Design Criteria, latest edition, and the criteria documents referenced therein
DOD 5100-76M	Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives
TM 5-800-1	Construction Criteria for Army Facilities, latest edition
NFPA	Building Occupancy Classifications
NFPA 101	Life Safety Code, latest edition
UBC	Uniform Building Code
UFAS	Uniform Federal Accessibility Standards

Requirements established by the installation DPW, Base Civil Engineering Office, or the Using Agency Other Model Codes that may be in use at a particular installation Requirements of state and local governmental agencies (Health Department, Environmental, etc.) that are applicable.

3.0. PRE-CONCEPT/PRE-PROJECT DEFINITION (10%) CONTROL DATA SUBMITTAL REQUIREMENTS.

3.1 Submittal. Some large or significant projects may require a study to be made before the 30% submittal in order to select the best possible design. When a 10 % submittal is called for in Appendix A of the contract, the architect shall submit separate concepts of the project (Concept A, Concept B, Concept C) consisting of single line site plan, floor plan and major elevations for each concept.

3.2 Design Approach.

Each concept must show the design approach in sufficient detail so that an evaluation by the COE and the Using Activity may be made with the A-E to arrive at the most feasible concept to prepare a 30% package. This submittal shall utilize full size drawing sheets.

3.3 Charrettes

When called for in the SOW, the design process known as the "Charrette" for obtaining a schematic design may be used as described in "The U.S. Air Force Project Manager's Guide to Project Definition". Additional information on this design process is also available through the Air Force Publication, "An Overview of Project Definition – Project Definition Tools."

4.0. CONCEPTS/EARLY PRELIMINARY (30% SUBMITTAL FOR AIR FORCE – 35% SUBMITTAL FOR ARMY PROJECTS) DESIGN SUBMITTAL REQUIREMENTS

4.1 Site Adapting.

When site adapting standard working drawings or using earlier designs at other locations, the design changes will generally be limited to the selection of alternate exterior or interior materials when such changes are economically justified and to changes necessary for updating for conformance to current criteria.

4.2 General Description of the Project.

State the purpose, function, and capacities in sufficient detail to delineate and characterize functional features and the desired image or visual appearance of the project. The narrative shall reflect the regional architecture as well as the visual characteristics of the existing facilities around the site. Include a statement of the NFPA Building Occupancy Classification, the UBC Type of Construction and the UBC Occupancy Group. Include also, a statement of any requirements for the physically handicapped and signage plans or graphics. Provide a brief statement of the interior and exterior finish materials to be used in the project.

4.2.1 Design Calculations.

Submit complete calculations for the following:

4.2.1.1 Gross building areas in accordance with AEI Design Criteria.

4.2.1.2 "U" values for each exterior wall assembly and roof assembly.

4.2.1.3 Calculations for toilet fixture/urinal/lavatory count.

4.2.2 Guide Specifications

Guide specifications shall be the latest version of the COE Guide Specifications as described in this Guide. Submit an outline including each specification and a general description of the materials intended for the project.

4.3 Architectural Drawings.

Drawings shall be provided in sufficient detail and so annotated for the using service to visualize precisely how the designer has interpreted the user's functional and operational requirements in his proposal for final design. Drawings shall include, but not be limited to, the following:

4.3.1 Single line perspectives, where required.

4.3.2 A Composite Floor Plan

The main floor plans shall be drawn in segments in order to comply with the requirements on the proper scale, provide a smaller scale floor plan showing exterior walls, interior partitions, circulation elements and cross referencing for enlarged floor plans and sections. Show overall dimensions on floor plan and gross building areas tabulated on lower portion of plate.

4.3.3 Demolition Floor Plans

Demolition floor plans showing clearly the work required on renovation and modification projects. Where work is extensive, larger scale more detailed plans may be necessary.

4.3.4 Floor Plans for Each Floor

Floor plans for each floor shall be shown at 1:50 or 1:10 scale if metric (1/4 inch scale if small building or 1/8 inch scale) with major elements enlarged on another plate. Show gross floor area tabulations if no composite sheet is included. Show the room name and net floor area in each room on the plan. The A-E will certify that the mechanical space is of sufficient size to accommodate and serve all mechanical equipment shown and specified by the mechanical design. See Exhibit 1, "Certificate for Design".

4.3.5 Building Elevations

Provide elevations showing grade lines, openings and principal exterior materials.

4.3.6 Building Sections

Provide cross sections as well as typical wall sections (large scale) at major components. Sections shall be unbroken where practical and show materials, floor-to-floor height and steps or stairs.

4.3.7 Fire Protection Provisions

Fire prevention/life safety drawings as required by Chapter 11, Fire Protection/Life Safety.

4.3.8 Provisions for the Physically Handicapped

The A-E shall include the provision of ER 1110-1-102 and EM 1110-1-103, Design for the Physically Handicapped, in all facility designs when indicated in the SOW.

4.3.9 Interior Design Analysis

Submit when required by contract, a statement of "Interior Design" objectives. This statement shall explain the interior design philosophy of the facility or family housing units, and the relationship of the architecture to the finishes and furnishings selected. The statement shall include, when applicable, comments on energy efficiency, safety, health, maintenance, image, personal performance of occupants, and functional flexibility. Provide submittals including furniture footprint plans, fabric and finish boards, interior sketches showing finishes and furnishing as they relate to architecture, order forms, and finish schedules. Many Army projects may require the same information when required by contract.

5.0. SIXTY PERCENT (60%) DESIGN SUBMITTAL REQUIREMENTS (AIR FORCE PROJECTS ONLY)

5.1 Concept Submittal Review Comments

Implement concept submittal review comments.

5.2 Floor Plans

Floor plans shall show functional arrangements of all areas, including corridors, exits, stairs and utility spaces properly related to exterior access roads, parking, service areas, etc. Grid system coordination of architectural

and structural systems shall be indicated. Walls, interior and exterior, shall be drawn to scale and have material indications. Identify firewalls and smoke partitions. Include door and window numbers, door swings, space names, space numbers, section cuts, etc. Reference all section cut lines on plans to the appropriate detail. Show gross floor areas for each floor and for the building/unit.

5.3 Elevations

Exterior elevations shall be drawn to scale showing all windows, doors, louvers, canopies, platforms, gutters and downspouts, visible structural frame and panels, grade and footing lines, and building control joints. Note differences in materials. Window and door symbols and numbers shall be shown.

5.4 Sections

Typical cross sections through the entire building/unit shall be shown. Typical wall sections shall be provided in sufficient number and size to convey adequately the intended construction.

5.5 Roof Plan

A roof plan showing roof slopes, gables, eaves, valleys, drainage, scuppers, roof-mounted equipment, skylights, traffic surfaces (walkways) where required, VTR's, etc., shall be shown.

5.6 Schedules

5.6.1 Finish Paint and Color

A Finish Paint and Color Schedule shall be provided for each building/unit.

5.6.2 Doors

Door schedules shall follow the floor plan or plan areas to which the doors pertain. Door details shall be placed on the same sheet, where possible, with the door schedules. If not possible, door details shall immediately follow door schedule.

5.6.3 Windows

Window schedules may, where appropriate, be placed on the same sheet with the door schedule or the floor plan, or may be placed on a separate sheet with window details. Indicate method of compliance with energy conservation requirements contained in the Architectural Design Criteria TI 800-01.

5.6.4 Equipment Schedules

Where food preparation and serving equipment are required, a schedule fully defining the equipment shall be included. This may be provided on a "blow-up" plan sheet of the area where food service equipment is to be installed or on a separate sheet immediately following the kitchen food preparation service area and its details. Schedule format for food service equipment is issued separately. Medical facility and family housing casework and equipment schedules shall be provided in a similar manner.

5.6.5 Furnishings and Equipment Plan

When required by the contract, submit plans for each floor showing the location and type of all furniture and furnishings to be installed by the Contractor. Indicate by schedule which items shall be furnished by the Contractor (CFCI) and which shall be furnished by the Government (GFCI/GFGI).

5.6.6 Signage

Verify the graphics requirements with the COE, and justify the system selected. This shall include signage for the building(s)/unit(s) and the site. All interior signage shall conform to ADAAG. All exterior signage shall be in accordance with the "Installation Design Guide" for each respective Post or Base where available.

6.0. FINAL (90% SUBMITTAL AIR FORCE – 100% SUBMITTAL ARMY) DESIGN SUBMITTAL REQUIREMENTS

6.1 Concept and Preliminary Comments

Implement previous comments. Provide a response to each review comment.

6.2 Final Drawings.

Final drawings shall show all pertinent plans, elevations, section, details, schedules and notes to present a complete description of the construction required. All drawing sheets shall have Norfolk District File Numbers and Norfolk District Drawing Numbers as shown in Index of Drawings. Architectural drawings shall be coordinated with the civil, structural, mechanical, electrical and site drawings and with the specifications. Dimensions, schedules, sections and details shall be completely checked. Door, window, and space numbers or symbols shall be properly shown. Locations of wall sections and cross sections shall be shown on plans and elevations. All errors and discrepancies noted shall be corrected. Ensure drawing index is complete and coordinated with the drawings. Coordinate reflected ceiling plans with lighting and air conditioning plans.

6.3 Specifications

Specifications shall be written or edited using the latest CE or Navy guide specifications. Notes to the specification writer shall be thoroughly reviewed before marking for typing. The specification writer shall be most familiar with the drawings, and shall coordinate his work with the person(s) doing the plans so that there will not be discrepancies.

7.0. CORRECTED CONTRACT DOCUMENT, SUBMITTAL REQUIREMENTS

7.1 Final Submittal

The corrected final submittal is not to be considered a normal design submission and will be provided in those cases in which the review comments require revision due to A-E error or omission.

7.2 Implementation

Implement final review submittal comments.

7.3 Verification

Verify consistency between plans, specifications and final corrections.

7.4 Corrections

Corrections to final design documents may occur during advertisement of the project, if this occurs, corrections shall be submitted in amendment format.

8.0. TECHNICAL REQUIREMENTS

In addition to the Criteria contained in the following paragraphs, architectural design shall comply with Chapter 6, Architectural Design Criteria TI 800-01 for Army projects and with MIL-HDBK-1190 for Air Force projects. Materials and construction methods shall comply with the instructional notes inserted in the applicable guide specifications.

8.1 Site Work

8.1.1 Access to Entrances

All stoops, steps, or similar required access to entrances that will normally be built by a Building Contractor as differentiated from sidewalks, driveways, etc., which are normally constructed by a paving subcontractor, shall be shown on the architectural drawings. Elevations of all these items shall be coordinated to assure proper drainage and compliance with accessibility criteria.

8.2 Masonry

8.2.1 Interior Walls and Partitions

Concrete masonry units in interior masonry walls and partitions shall be not less than 150 mm (6 inches) in nominal thickness, except where 100 mm (4 inches) in nominal thickness is allowed by the Uniform Building Code.

8.2.2 Coursing

Concrete masonry unit coursing shall be coordinated with door heights to eliminate the need for cutting a block.

8.2.3 Grouting

Grouting, between wythes of external masonry walls is not allowed. (Grouting of reinforced concrete masonry unit cores is allowed.)

8.2.4 Control Joints

Masonry control joints shall be shown on the 1/8" scale floor plans and on elevations. All control joints shall be detailed.

8.3 Miscellaneous Metals

All access panels required to service mechanical items normally furnished and installed by the nonmechanical trades shall be shown on the architectural drawings. Make sure that access panels, when required, are specified. All access panels in fire rated construction shall be appropriately rated.

8.4 Thermal and Moisture Protection

8.4.1 Roof and Wall Insulation

Except when required for refrigerated spaces, roof and wall insulation shall be drawn at a nominal thickness consistent with the insulation requirements of the particular building or project. R-values shall be indicated on the drawings. The thickness of roof or wall insulation shall not be dimensioned nor the thickness indicated on the drawings. Exceptions:

- a. In roofing alterations or reroofing projects where insulation is required only to provide required roof slope for drainage.
- b. Where insulation is used as back-up for a stucco type system finish only in alteration work to provide a new facade.

General standards for insulation, require insulation thickness as determined by the established "U" value for total roof or wall thickness stated in the Basis of Design. Unless specifically directed, "R" values shall be provided for insulation materials. Details shall allow for possible differences in insulation thickness. "R" values shall be shown on the wall sections for roof/attic, walls and foundation/crawl space.

8.4.2 Roof Slope

The minimum roof slope for built-up roof shall be 1:50 (1/4 inch per foot). The slope of built-up roof should be less than 1:6 (2 inches per foot). Single-ply roofs shall in general, conform to the minimum slope of 1:50 (1/4 inch per foot). Standing seam metal roofs shall be a minimum of 1:25 (1/2 inch per foot).

8.4.3 Sheet Metal

In all cases, sheet metal for various elements used throughout a building shall be of the same basic metal. Atmospheric conditions shall be considered in the selection of exposed sheet metal.

8.4.4 Downspouts

When downspouts are required, they shall not drain directly onto a walk, platform, or open ground. When downspouts must occur at walks or platforms, they shall pass through or under into underground drains or toward open ground beyond. Downspouts draining onto open ground shall be diverted to prevent erosion by utilizing splash blocks. Use of interior downspouts shall be avoided where possible. The use of scuppers should be maximized.

8.4.5 Gutters

The practice of using concealed gutters is generally discouraged except on facilities which warrant strong aesthetic design considerations. Any design utilizing concealed gutters will be required to use of either copper or stainless steel as the material specified for this application. A continuous membrane liner under the gutter is required as a backup system in the event of failure of the primary material. The A-E shall provide specific details on the plans of how expansion joint and drains connections are to be constructed as well as appropriate fabrication and installation details.

8.5 Doors

8.5.1 Pedestrian Doors

All pedestrian doors shall be 2100 mm (7 feet 0 inch or 7 feet 2 inches), or 2400 mm (8 feet 0 inch) high except in family housing where they may be 2000mm (6 feet 8 inches). Door openings shall, in general, be 900 mm (3 feet 0 inch) in width, except for special purpose doors, closets, family housing, etc. Refer to UFAS for handicapped requirements.

8.5.2 Room Doors

Doors to rooms shall be adequate size to accommodate the installation and removal of furniture and equipment installed herein.

8.5.3 Exterior Doors

Except in underground structures, doors to boiler or mechanical rooms shall normally be provided to the exterior for all buildings. Doors from the power rooms, generator rooms, etc., should be to the outside of the building only.

8.5.4 Special Doors

Special type doors such as rolling doors shall be adequately designed to safely resist the required wind pressures. Rolling steel or aluminum doors shall be designed to permit operation of the door at maximum wind velocities defined in the area where used.

8.5.5 Hardware Sets

When selecting hardware sets, limit the use of closers to reasonable locations. Parallel arm closers are required when the hinged jamb is less than 178 mm (7 inches) from the adjacent wall. Door locations should be studied in the design stage to eliminate the need for parallel arm closers. Limit the use of door coordinators at pairs of doors only in those locations where removable mullions cannot be used.

8.5.6 Designations

Hardware set designations shall be listed in the Door Schedule in reference to the location on the floor plans. The specification on builders hardware shall provide the necessary hardware set designation numbers and description of each hardware group to be inserted in the Door Schedule.

8.5.7 Air Intake Louvers

Overall size of return air or air intake louvers located in doors shall be indicated in the Door Schedule. Minimum bottom rail dimension shall be 75 mm (3 inches) and the minimum stile dimension shall be 125 mm (5 inches). Variable louver dimension shall be in height only, for simplicity and appearance.

8.6 Finishes

8.6.1 Color Schedules

Color for color schedules (excluding prefinished items) for all Army projects shall be selected from FED-STD 595. For Air Force projects, the use of FED-STD 595 for color schedules (excluding prefinished items) is optional, but color boards (assembled in binders) displaying all colors shall be provided to the District Architecture Section. FED-STD 595 Color Volume I notebook, with color chips for desk use, and 75 x 175 mm (3-inch by 5-inch) color chips by sets, can be ordered from the following address. Specification Section 09915 shall be used to indicate color selections.

Global Engineering Documents
1990 M Street N. W.
Suite 400
Washington, D.C. 20036
1-202-429-2860

When approved by the District Architecture Section, colors may be selected from manufacturers standards with the selection identified for color purposes only.

8.6.2 Acoustical Plaster and Acoustical Tile

The use of acoustical plaster is discouraged. In electronic and communications facilities in which avoidance of dust is a major consideration, acoustical treatment shall be limited to acoustical tile with nondusting characteristics.

8.7 Rooms and Spaces

Rooms and spaces for utilities, including mechanical and electrical equipment rooms and chimneys, shall be indicated on Concept drawings, even though their exact size and location is undeterminable at the Concept stage. At times, the technical and servicing requirements of the equipment necessitate increases in the areas allocated in the Concept Drawings.

8.8 Floor Drains and Slopes

Floor drains and shower heads shall be shown on architectural drawings as well as on mechanical drawings, and shall be closely coordinated. All floors in areas requiring drains shall be sloped toward the drains, and coordinated with structural drawings for recessed concrete requirements.

8.9 Arms Vaults

Arms vaults where called for and required shall be designed in conformance with all applicable D.O.D. criteria.

9.0. MILITARY INSTALLATION AESTHETIC IMPROVEMENT GUIDANCE

9.1 Discussion

The aesthetic quality of an area is not determined solely by the architecture of its buildings, the complexity of its site development and landscape features, or the size shapes, colors, and textures which are predominate; it is determined by how well all these elements function together and complement existing natural and man made features. There has been very little criteria or guidance for assuring the preservation or improvement of the aesthetic character of existing or newly constructed facilities and sites. This Engineering policy will provide an effective vehicle of communication between participating personnel to achieve harmony of design, and assure a consensus of opinion in the approach to aesthetic quality.

9.2 Policy

The A-E shall be responsible for insuring that proper attention is paid to achieving an aesthetic design solution which includes harmony of design and the visual linkage of architecture to the surrounding community. New design projects shall respect the architectural character of existing facilities that are to remain and that are considered to be architecturally appropriate for the environment. Where the architecture of existing permanent facilities reflect a predominant character or style, the new facilities shall be designed to be in harmony with that character or style. This emphasis will also be placed on landscaping and structures other than buildings. Where available, Installation Design Guides shall be reviewed before beginning any design effort.

9.3 Application

The exterior perspective requirement applies to facilities having a significant visual impact within an installation and/or occupancy which requires special design attention. The A-E shall be notified when this requirement exists. The following items shall be addressed in each design:

- a. The architects shall take the lead and insure all designers consider the effects of their decisions upon the project aesthetics.
- b. The designer(s) shall provide a descriptive narrative of the design approach used for each project.
- c. During concept design, a site visit shall be made for familiarization and color photographs taken of the surrounding area.

---END OF CHAPTER---

CHAPTER 7

Structural

1.0 GENERAL.

This chapter states the minimum structural design requirements for each of the contract submittal stages.

2.0 PRE-CONCEPT/PRE-PROJECT DEFINITION (10%) SUBMITTAL REQUIREMENTS.

No submittal requirements.

3.0 CONCEPT/PROJECT DEFINITION (30%) DESIGN SUBMITTAL REQUIREMENTS.

The structural portion of the 30% design brochure must outline the proposed methods and materials of design and construction for approval. An outline of the required brochure is shown in this Design Guide. Include the following:

3.1 Structural Narrative.

3.1.1 General. Use present tense order for all paragraphs. Provide a general description of the scope of the project and all the major structures. Give overall building dimension and a description of the principal features such as wall and roof construction. If the building is irregularly shaped, explain where seismic joints will be placed to create regular shapes or provide a statement that dynamic analysis of the building will be performed.

3.1.2 Framing System.

- a. Provide a brief description of the framing system chosen and the reasons why. If a Structural System Selection Analysis (economic justification) was required then this paragraph should summarize the results of that analysis. Provide the analysis to justify the framing system selection.
- b. Provide a brief description of the lateral load resisting system and how these loads will be transmitted to the foundations.

3.1.3 Foundation. Give a brief description of the anticipated foundation based on similar construction in the area.

3.1.4 Special. List special design features.

3.1.5 Fire Resistant Statement. State the required fire resistance criteria for all portions of the structural system and the propose method of meeting these requirements.

3.1.6 Information Request. List of structural information needed from the COE to complete final design.

3.1.7 Design Criteria. Provide a list of structural design criteria and codes that will be used in the design.

3.2 30% Design Analysis. The following specific items shall be included.

3.2.1 Load Assumption. State the live loads to be designed for, include roof and floor loads. Calculate the wind loads and lateral earth pressure loads.

a. Calculate both positive and negative wind pressure with the controlling pressures summarized in tabular form. Include the following wind pressures as a minimum: wind on frame, wall, wall corners, roof, roof ridges, eaves, and roof corners.

b. Calculate the basic seismic loading for the frame or lateral load resisting system and contrast them with the comparable wind loads. Detailed calculations for seismic loads on parts and portions are not required at this submittal level.

3.2.2 Working Stresses. Describe the value to be used for the allowable or working stresses of the principal structural materials.

3.2.3 Structural Calculations. Furnish calculations for typical roof, floor, and foundation members as applicable for the structural system proposed to be used in addition to the loading calculation required above.

3.3 Structural System Selection Analysis. For all projects with a construction value of \$3,000,000 or greater furnish a comparative analysis of at least three competitive structural systems. These structural system alternatives are defined as the consideration of different structural materials and different framing system supporting the loads imposed on the structure. Different structural systems are not the variation of the same framing scheme (i.e. changing bay widths of a steel frame). A portion of each facility, large enough to be representative of the entire structural system selection. The portion of the structure selected for comparing alternate system cost must be based upon a concept of the complete building configuration, including architectural, mechanical, electrical, and other systems. Hence, the main structural members must be sized to check for compatibility with ceiling, duct, lighting, and all other space demands. Determine the method of providing the required degree of fire resistance for each alternative, and the cost included. Include the following items in the DA.

a. A complete description, with sketches, of each structural system considered.

b. Design calculations supporting the member sizes used for the cost estimate.

c. A comparative cost for each system, clearly showing all costs and quantities used.

d. An analysis of the study result, with justification for the system selected.

3.4 30% Drawings. Furnish sufficient framing plans for roof and floors, as applicable, to indicate layout of principal members. Typical sections should be furnished through roof, floor, and foundation indicating materials and type of construction proposed. These details may be shown on the architectural drawings. Furnish a plan identifying the location of all seismic joints.

3.5 Outline Specification.

Review the list of CEGS in this Guide and indicate those sections proposed to use at the end of the 30% structural narrative.

4.0 PRELIMINARY (60%) DESIGN SUBMITTAL REQUIREMENTS.

The Preliminary Design represents approximately 60 percent of the total structural design effort.

4.1 60% Design Analysis. Include all items in the 30% Design analysis and any revision necessitated by comments on the 30% Submittal. The DA shall be substantially complete for all the major structural features of the primary structure and include, but not be limited to, the following:

4.1.1 Narrative. A brief narrative that provides the reference, design loads, assumed allowable stresses, and a brief description of the structure to include type of foundation, type of framing, and method of resisting lateral loads.

4.1.2 Criteria. A synopsis of special design criteria or technical requirements provided as a result of site visits or correspondence with the PE/A. Copies of any letters or minutes of meetings which provide structural guidance not otherwise contained in this Guide should be included in this section of the design analysis.

4.1.3 Calculations.

- a. Complete calculation of seismic and wind loads for final design to include distribution of these loads to the lateral load resisting elements.
- b. Design calculation for roof and floor decks, beams, joist, girders, and columns as applicable.
- c. Design calculations for horizontal diaphragms and bracing to include shear transfer connections.
- d. Design calculations for exterior cladding (Masonry, steel, precast concrete) for flexure, shear, and overturning as appropriate.
- e. Design calculations for shear walls and bracing.

4.1.4 Checking. Checking of the design at this stage will not be required. This submittal will not normally include the design of lesser related structures such as utility vaults, pits, tanks, retaining walls, tank hold down pads, etc. The Structural design of these structures is the responsibility of the structural engineer even when shown on drawings for other disciplines. The design analysis of these structures is required at final design.

4.2 60% Drawings. Include the following as applicable:

4.2.1 Plans. Foundation plan, framing plan for each floor, and roof plan for the building. Show grid lines or center lines for columns on the plans for buildings framed with columns and beams. In framing plans consisting of repetitive bays, only detail a typical bay to indicate the proposed framing.

4.2.2 Joints. Layout of floor joints in slab on grade. Layout of construction, control, expansion, and seismic joints in foundation, floor, and building framing.

4.2.3 Sections. Typical sections through foundation, floor, and roof framing for buildings.

- a. Plans and sections of structures other than buildings.
- b. Additional sections and details as required to illustrate any special items or methods of framing for which approval is sought.

4.2.4 Special Notes. Pre-Engineered Building Notes.

4.3 60% Specifications. Only outline specifications are required at this submittal.

5.0 FINAL (90%) DESIGN SUBMITTAL REQUIREMENTS.

5.1 Design Analysis. Furnish complete checked calculations for all structural members. Incorporate any changes required by comments on 60% Submittal.

5.2 Drawings. Furnish complete final plans and details of all structural elements. Before this submittal, coordinate structural drawings with all other design disciplines. Always include the items listed below on the final drawings if applicable:

- a. Roof framing plan and details including details of any opening in the roof.
- b. Intermediate floor framing plans and stair details on multiple story structures.
- c. Stress or load diagrams of features to be construction contractor designed (i.e., connector plates on wood trusses are construction contractor designed based on member stress information shown by the Engineer on the structural drawings).
- d. Column schedule, beam schedules, and connection schedules.
- e. Foundation plan including any notes relative to special foundation treatment required and cross references to proper specification sections.
- f. Foundation section and details.
- g. Layout of expansion, construction, and dummy joints in floor slabs; horizontal and vertical joints in foundation walls; joints in footing; and layout of control joints in masonry walls.
- h. Typical and specials section are required.
- i. Details of expansion, construction, and contraction joints in concrete.
- j. Layout and detail of exterior entrance pads and steps.
- k. Details of any special items.
- l. General and special notes as required except that the term "others" shall not be used.

5.3 Specifications. Submit a complete set of final specifications and a marked up set of structural specification sections for review

5.4 Quality Assurance. Check final drawings, specifications, and Final Design Analysis by the same structural engineer other than the designer. Coordinate structural drawings with the other disciplines and with the specifications. Engineers and checkers must initial the applicable pages of the D.A. and drawings.

6.0 CORRECTED FINAL (100%) DRAWING SUBMITTAL.

6.1 General. The 100% submittal is not considered a formal design level and is required only when the final submittal must be revised or corrected due to error or omission.

6.2 Design Analysis. Furnish final structural calculations, incorporating any and all changes made during the process of review and redesign. Calculations shall be checked and verified by a structural engineer other than the original designer.

6.3 Drawings. Incorporate all approved comments from previous submittals. Finalize all drawings and verify consistency with the plan and specifications.

7.0 ADDITION OR MODIFICATIONS TO EXISTING STRUCTURAL.

7.1 New Work. When new work is added to an existing structure or an existing structure is modified, the structural engineer is responsible for determining the adequacy of the existing structure for the addition or modification.

7.2 Inspection Report. Inspect the existing structure for the purpose of determining the condition and measurement of the areas affected by the new work. Include a narrative in the 30% Design that outlines the results of this inspection. Describe the layout and details of the existing structures. State the calculated capability of the structure to support the new loads, and describe the strengthening that will be required.

7.3 Code Search. Determine whether seismic or wind upgrade of the existing structure to meet the latest criteria will be required.

8.0 SITE ADAPTING GOVERNMENT DESIGNS.

Where standard drawings or other drawings are to be site adapted the following applies:

8.1 30% Design. The 30% submittal is as previously described with the following clarifications:

- a. A selection analysis is not required.
- b. Wind and seismic calculations shall be performed to determine whether the controlling lateral loads are higher or lower than the original design. Redesign the structural features to resist the higher loads. Fully describe those items to be strengthened.

8.2 90% Design. Final design consists of complete plans, specifications, and design analysis. The specifications shall be project specification updated to include the latest revision to the Federal and Military Guide specifications, design codes, and criteria. The design analysis shall include a narrative explanation of all changes to the original design to accomplish the site adaptation with backup calculations.

---END OF CHAPTER---

CHAPTER 8

ELECTRICAL

1.0 GENERAL.

This chapter gives general guidance for the preparation of drawings, specifications and design analysis as related to electrical aspects of military construction projects.

2.0 APPLICABLE PUBLICATIONS.

The most current editions of the publications listed below constitute an addendum to this chapter wherever referenced or applicable.

- a. Air Force Manuals and Regulations.
- b. Technical Instructions Design Criteria TI 800-01.
- c. Engineer Technical Letters (ETL) and Engineering Regulations
- d. Military Handbook, Manual and Standard.
- e. Department of the Army Technical Manuals (TM).
- f. American National Standard Institute (ANSI).
- g. National Association of Corrosion Engineers. NACE RP-OI-69
Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
- h. National Fire Protection Association.
- i. Corps of Engineers Guide Specifications (CEGS).
- j. TIA-EIA Telecommunications Building Wiring Standards.
- k. ETL 1110-3-502 Engineering and Design –Telephone and Network Distribution System
- l. Military Handbook 10086 Fire Protection for Facilities Engineering Design and Construction
- m. Military Handbook 1012/3 Telecommunications Premises Distribution, Planning, Design, and Estimating

3.0 PRECONCEPT/PRE-PROJECT DEFINITION (10%) SUBMITTAL REQUIREMENTS.

Describe the available electric power and communication infrastructure for this stage. Coordinate with local DOIM, ISEC, and User to ensure that the scope of the telecommunications and data systems work is clearly defined and that the divisions of work responsibility for all parties is as agreed upon in the signed letter of intent (see ER 1110-3-110).

4.0 CONCEPT/PROJECT DEFINITION DESIGN (30%) SUBMITTAL REQUIREMENTS.

4.1 Design Analysis. Include estimated connected load schedule, data and calculations to support design decisions.

4.2 Interior Electrical System Design Narrative. Include the following:

4.2.1 Characteristics. Indicate electrical characteristics (phases, voltage and number of wires) of electrical system. State basis of voltage selection based upon system economy.

4.2.2 Lighting. Provide a brief description of the lighting system(s) to be used for major areas. Include a concept lighting fixture schedule showing room name and/or number, lighting intensity, type of fixture (by standard drawing number or catalog number), voltage, amperage, mounting (wall or ceiling), mounting height, and basis of design such as I.E.S., etc.

4.2.3 Wiring. State type of wiring system, such as, rigid conduit or intermediate conduit, electrical metallic tubing, nonmetallic sheathed cable, etc., and where it will be used.

4.2.4 Specials. Provide paragraph describing proposed addition and alterations of special items of design, such as, specialized equipment, special receptacles, physically disabled and seismic requirements, etc. Include a description and location of special power outlets and circuits (volts, phase, and amps). Include documentation of the source of the criteria. Where there is a large concentration of non-linear loads such as ADP equipment, variable frequency drives, etc, address proposed distribution system features that will be designed to deal with harmonic currents.

4.2.5 Hazard Classes. Define any hazardous area by class, division and group as defined in the National Electrical Code (NEC) and indicate type of equipment proposed for use in the area.

4.2.6 Lightning Protection. Describe lightning protection system; if none, so state. As a minimum perform "Risk Assessment Analysis" as described in NFPA 780. Refer to TM 5 811-3 for additional guidance.

4.2.7 Grounding. Describe grounding system to be installed, if required. If a counterpoise, grid, etc, is to be used, state the standards to be used in design and calculations.

4.2.8 Service. Describe service entrance and service equipment selected as a result of load, voltage drop and fault current calculations. Provide these calculations with the Design Analysis.

4.2.9 Equipment Data. Describe basic characteristics of panelboards, protective devices, switchgear, motor control center or other major equipment to be provided. Describe any Government Furnished Equipment (GFE) to be included in the project and any special installation and testing requirements.

4.2.10 Corps of Engineer Guide Specifications (CEGS). List CEGS that will be used. List all systems or materials for which no CEGS have been developed and for which specifications must be written for this project. Custom specifications must be non-proprietary and written in CEGS format.

4.2.11 Brand Names. Provide a firm statement that no brand names or proprietary items will be used in final plans and specifications. Any exception to this must have prior approval of the District.

4.2.12 Metering. Describe electrical metering equipment to be provided. If the Installation has an EMCS System coordinate metering requirements with the energy analysis.

4.2.13 Systems. Where existing transformers, lighting ballasts, capacities, etc. will require removal, indicate PCB handling and disposal requirements per EPA regulations.

a. Describe any additional electrical requirements such as communication, alarm detection, or electronics requirements.

b. Describe type of fire detection and alarm system.

c. Describe the intrusion detection. (Unless specifically funded on the project's DD Form 1391, only conduit and boxes shall be provided for Intrusion Detection System. Equipment to be connected to the conduit and box layout will be provided by the Using Activity. Design information on conduit and box locations and sizes will be furnished by the Using Activity.)

d. Describe the telephone system requirements including the type system, the type of instruments and the size of the installation including stations, trunk size, connection to and location of switch, and all instructions received from the Directorate of Information Management (DOIM)(Army) or the Base Communication Office (BCO) (Air Force). Telephone/data systems shall be designed in accordance with MIL HDBK 1012/3 ETL 1110-3-502, ER 1110-3-110 and EIA/TIA Standards.

4.2.14 Where systems furniture will be provided either under the construction contract or post contract, describe power and communication provisions that will be provided to support wired furniture systems.

4.2.15 Miscellaneous Information. Additional information or material required to complete design shall be listed, or a statement shall be made that none is needed.

4.3 Exterior Electrical Distribution System Design Narrative. The exterior design shall be a narrative presentation and shall include the following:

4.3.1 Primary. Contact the DPW/BCE to obtain information relative to the adequacy of the primary supply at the point of takeoff. If the primary source is inadequate, state measures proposed to correct the deficiency in the design. Certify that this contact has been made.

4.3.2 Power Supply. Provide electrical characteristics of power supply from the service point to the main service equipment (voltage, phase, number and size of conductors).

4.3.3 Connected Load. Narrate conclusions in the D.A. related to the estimated total connected load and estimated kVA demand load. Indicate type, number, kVA capacity of transformer installation proposed. State primary and secondary connection of transformers (i.e. 12470 to 480Y/277 volts, Delta-wye).

4.3.4 Distribution. State basis for selection of primary and secondary distribution voltage, i.e. 480Y/277 vs. 208Y/120.

4.3.5 Conductor. State type of conductor, such as copper or aluminum, and where they are proposed to be used and a justification for the choice made.

4.3.6 Design Standards. Provide a statement describing standards of design such as, primary and secondary voltage drop, and physical characteristics of aerial or underground circuits. State the basis for the selection of aerial or underground distribution. State actual primary voltage drop for size of primary distribution conductors proposed to serve the load. Reference applicable conclusion and/or calculations in the D.A. State short circuit current available at project site if it can be obtained from the user. If not, so state.

4.3.7 Exterior Lighting. Provide a statement describing street lighting, security, parking lot lighting, or sidewalk lighting requirements. Types of fixtures, pole heights, and proposed lighting intensities are to be included.

4.3.8 CEGS. Provide a list of CEGS that will be used. Listing may be included with interior guide specification list.

4.3.9 Cathodic Protection. Where cathodic protection is required by the project criteria or other instructions, provide recommendations for the need and type of system to be employed.

4.3.10 Scope of Exterior Work. Provide a statement describing the extent of any exterior work such as telephone lines, television (TV) distribution cables, etc. State whether circuits are aerial or underground. If underground state whether direct burial or concrete-encased duct bank. Include all information and instructions

received from the Activity's Director of Information Management (DOIM) or Air Force Base Communications Office.

4.4 Field Trip Report. A field trip report should be furnished. This report should contain record of meeting held with facility personnel, including participant lists. Any agreements or understandings reached with facility personnel or any unforeseen site/building conditions should be documented in the report.

4.5 Energy Conservation Design Narrative. Energy conservation measure shall be indicated (see applicable energy conservation publications). The electrical engineer shall be a team member of energy budget preparation and shall provide necessary information to the architect and mechanical engineer for inclusion in the energy budget. Describe measures and techniques that are proposed in the electrical design that will conserve energy.

4.6 30% Design Drawings.

4.6.1 Interior Electrical. Provide interior electrical drawings showing only special purpose power outlets, locations of telephone backboards, electrical service equipment, service entrance, and preliminary single line diagram. Also, show demolition work, if any.

4.6.2 Site Plan. Provide a separate electrical site plan indicating all existing and proposed support utility lines and equipment required to serve the project including electrical power lines, all roads and driveways, parking areas, and other items necessary for functional and operating adequacy. Indicate the extent of any demolition to be done. If extensive, provide separate drawings with independent legend for new work.

4.6.3 Characteristics. Provide electrical characteristics (voltage, phase, number, and size of conductors) for the primary and secondary lines at the point of delivery and/or any extension. Indicate characteristics and standards of design for aerial or underground lines.

4.6.4 Capacity. Indicate the type, number, location, kVA capacity, primary and secondary voltage of the transformer installation proposed. Identify the primary and secondary connections of the transformer(s).

4.6.5 Lighting Intensity. Indicate intensity and type of exterior lighting proposed (street lighting, security lighting, or parking lot lighting).

4.6.6 Communications. Identify any existing and new communications service connections, both aerial and underground. Indicate characteristics and standards of design for aerial or underground communication lines. Identify size and location of all telecommunication/data equipment rooms and closets.

4.6.7 Additional Criteria. Any additional criteria, deviations concerning criteria, questions or problems shall be listed in the design narrative.

5.0 PRELIMINARY (60%) DESIGN SUBMITTAL REQUIREMENTS.

5.1 Design Analysis. The D.A. shall be an entirely updated analysis (not amendments to 30% submittal) to permit verification that the design complies with the criteria furnished and the approved 30% Design phase and approved review comments.

5.1.1 Interior Electrical Work. Determine estimated demand loads. Provide sizes of feeders, service entrance, and transformers. Provide photometric calculations for lighting fixtures. (Individual circuit load tabulations and interior voltage drop calculations are not required for this submittal.)

5.1.2 Exterior Electrical Work. Determine and state the estimated primary and secondary wire sizes and transformer sizes.

5.2 Electrical Design Drawings.

5.2.1 Exterior Mechanical.

- a. Exterior electrical layout plans are required and must be separate from water, sewage, and other utility plans. Show other new or existing utilities only as required to prevent conflicts with the electrical work.
- b. Complete all exterior electrical plan with poles and other pertinent components indicated. Include transformer location, kVA, voltage and phase characteristics and conductor type, size and number. Show manholes details on final drawings.
- c. Where cathodic protection has been recommended and approved at the 30% Design stage, indicate the extent and layout of the system on the drawings.
- d. Indicate location and type (aerial or underground) of all new communications, primary and secondary lines, service drops, and transformers. Show conductor sizes and material types.
- e. Indicate poles and equipment to be relocated or removed. Clearances from buildings shall be in accordance with the National Electric Safety Code.
- f. Indicate location of any relocated electrical items.
- g. Show accurate location and sizes of existing lines including poles and transformers from which power is to be obtained.
- h. On large projects where underground systems are used, furnish prints of the site showing communication service connection points of each building, manholes and final connection to the existing system.

5.2.2 Interior Electrical.

- a. The interior electrical drawings shall include the designation of all rooms and work areas by name and room number as shown on the architectural or other drawings.
- b. Show service drop or lateral connection location.
- c. Power riser diagram for the typical building shall be essentially complete except for finalization of conduit and wire sizes.
- d. Panelboards, motor control center, switchgear equipment and all utilization equipment shall be located with schedules and physical layout arrangement completed.
- e. Show the location and type of lighting fixtures to be installed in each area.
- f. Complete lighting fixture schedule shall be included on the drawings.
- g. All removals, if any, must be shown. If removal is extensive, separate demolition plans are required.
- h. A complete symbol legend for all devices or equipment shall be shown on the plans, except that legend for aerial and/or underground exterior electrical work may be separate and shown on the exterior plans.
- i. Include special features such as underfloor raceways, clock system. Fire alarm system, exit lighting, bus duct, communication facilities, etc.

j. Interior wiring need not be shown on preliminary electrical plans; however, provide notes indicating the type of wiring system (conduit, EMT, nonmetallic sheathed cable) proposed and whether wiring system is exposed or concealed.

k. Show an interior telephone system consisting of the conduits, cabinets, etc. as required by criteria.

l. Show location, electrical characteristics, and kW (if applicable) of electrically driven equipment on the drawings.

m. Define the limits of all hazardous areas and indicate the Class, Division, and Group which applies per the NEC.

n. Provide riser diagrams for fire detection and alarm system, intrusion detection and alarm system, intrusion detection conduit system, public address system, telephone/communication system, etc. Riser should show the location of the various components and interconnections with other systems such as HVAC and hood fire suppression connections to fire alarm panels, etc. Conduit wire size, and quantity of wire should not be shown on the riser diagrams for the fire protection system since these vary between manufacturers.

o. Show location of all devices and equipment for signal systems on the floor plans. Show location of devices to be interconnected, e.g. show duct-mounted smoke detectors, hood fire suppression systems contacts for fire alarm system input, etc.

p. Verify implementation of the 30% approved comments.

5.3 Outline Specifications.

5.3.1 Provide final outline specifications updated from those previously furnished in the 30% submittal.

5.3.2 Where no CEGS sections or standard specification sections are provided, prepare an outline of the new specification section from available criteria and instructions giving all pertinent material characteristics. Custom specifications must be written in CEGS format.

6.0 FINAL (90%) DESIGN SUBMITTAL REQUIREMENTS.

6.1 Final Design Analysis.

6.1.1 Submittal. Submit an entirely updated design analysis (not amendments to previously submitted design analysis) to support this submittal. Implement previous submittal approved comments.

6.1.2 Calculations. Provide design calculations and supporting documentation to support design considerations. Indicate the names or initial of these individuals on the page or insert carrying the calculations. Supporting documentation shall be clear, and formulas and references shall be identified. Assumptions and conclusions shall be explained and cross-referencing shall be clear. Include calculations and data for the following in the analysis:

a. Lighting calculations, interior and exterior. Calculations shall use IES methodology.

b. Short-circuit calculations. Carry calculations to a point to demonstrate all system components are adequately rated.

c. Voltage drop calculations for all feeders and worst case branch circuits.

d. Existing loading data where connections are made to existing transformers or load centers including method determining the availability of sufficient capacity the additional loads.

e. Calculations of all connected loads, demand factors, and demand loads by circuit number for each panel and switchboard. Show circuit breaker and fuse interrupting rating for each switchboard and panelboard.

f. Calculations for cathodic protection.

g. Trade names are not allowed on the contract plans and specifications; however, for lighting fixtures and other equipment such as motor control centers, switchgear, bus duct, transformers (where special features are required), special receptacles, etc., include the current manufacturer and catalog number of the equipment in the Design Analysis.

h. TV system dB loss calculations.

6.2 Final Design Drawings. The final drawings are an extension of the approved 60% drawings. Incorporate all previous approved comments.

6.2.1 Details. Include all details for final package on drawings. For congested areas that might interfere with various electrical systems, cable trays, piping, ducts, etc., thoroughly detail by expanded scale drawings.

6.2.2 Checking. Thoroughly check the drawings for discrepancies, for compatibility between drawings and specifications, and for compatibility between disciplines.

6.2.3 Provide complete one-line diagrams for all power and signal systems.

6.3 Specifications.

6.3.1 References. Add publications references, paragraphs, phrases, words and sentences for items not adequately covered by specifications.

6.3.2 Propriety. Do not specify proprietary items unless prior approval has been obtained.

6.3.3 Availability. Ascertain that major or special types of equipment are available commercially.

CORRECTED FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS.

The 100% submittal is not considered a formal design level and is provided in those cases in which the approved comments require revision due to error or omission. Incorporate the approved comments generated during the final review into the Final D.A. (not amended sheets), specifications, and drawings before they are submitted as 100% Design Documents.

8.0 TECHNICAL REQUIREMENTS.

8.1 Metering. Specify metering equipment on all main energy supplies for all buildings to be constructed. (See AF ETL 86-15, Utility Meter in New Renovated Facilities.)

8.2 Special Items. Include the following items in each submittal where applicable:

8.2.1 Clearances. Dedicated electrical space shall be provided around and above panelboards, switchboards, transformers, transfer switches, motor control centers and similar major items of electrical equipment. Define this space as stated in NEC.

8.2.2 Fire Resistant Ceilings. When the false ceiling is used as the fire resistant ceiling, specify lighting fixtures IAW Underwriters Laboratories Fire Resistance Directory. The lighting fixture specified shall be classified for fire resistance and be so noted in the lighting fixture schedule.

8.3 Fire Detection and Alarm System. Comply with the applicable requirements of MIL-HDBK-1008C.

8.3.1 Description. If an existing base fire alarm system is being expanded, the construction contractor does not normally supply the central station receiver module. However, any equipment supplied must be fully compatible with the existing system equipment, and if a receiver module is supplied it must be physically as well as electrically compatible. Determine the make and model of existing equipment and include sufficient information in the specifications and plans to insure compatibility of the completed system.

8.3.2 Specification. Where installations have central fire alarm receiving stations that are dependent upon a unique coding scheme, transmission to the central station fire alarm status panel at each project facility may be by a transmitter unique to the system and will, therefore, require that proprietary equipment be specified. Consult with the DPW before 30% Design to insure that proper procedures to specify this equipment are available.

8.4 Telephone/Communication System. Unless otherwise specifically directed, provide a complete telephone/communication system in the construction plans and specifications. Coordinate design with the Using Activity communications personnel.

8.5 Special Grounding System. Conform to MIL-HDBK-419A.

8.6 Radio Frequency Shielding. Conform MIL-HDBK-419A.

8.7 Cathodic Protection. Conform to:

a. AF ETL 91-6

b. Army TM 5-81I-7

c. The size and location of cathodic protection anodes and Test Stations must be shown on the drawing.

8.8 Seismic Design. Design IAW TM 5-809-10.

8.9 Surge Protection. Provide service entrance surge protection. (See AF EETL 90-6.)

8.10 Equipment. Identify switchboards, switchgear and panelboards on the drawings to coincide with the descriptive paragraphs for such equipment found in the technical specifications.

8.11 Transformer. Locate exterior transformer stations IAW MIL-HBDBK-1008C.

8.12 Address the disposition of salvageable and non-salvageable material removed under this project.

8.13 Identify facilities required for the handicapped in accordance with UFAS.

8.14 Where the using activity must remain in operation during construction, provide a specific and detailed sequence of constructing to minimize or eliminate interruption. Identify all required outages, advance notification, duration, preparations, and any temporary power requirements. Provide with final submittal.

---END OF CHAPTER---

CHAPTER 9

COST ENGINEERING

1.0 PURPOSE

This chapter provides specific guidance for the preparation of cost estimates for Military, Civil and HTW construction projects. Construction cost estimates serve several purposes, to include establishing program/project funding, controlling costs during design, evaluating bids, negotiating contracts and modifications, and used as a guide for the review and approval of contractor proposed "schedule of values" for payment purposes during construction. As such, they must be consistent with the best estimating practices in the construction industry, as well as being current, complete, and accurate. Cost estimates must be prepared to reflect the expected cost to the Government to perform the work by contract and include all reasonable cost which a prudent experienced and well equipped contractor might anticipate in his bid.

2.0 REFERENCE PUBLICATIONS

- 2.1 MCACES for Windows Users Manual
- 2.2 ER 111 0-1-1300, Cost Engineering Policy and General Requirements
- 2.3 ER 1110-3-1300, Military Programs Cost Engineering
- 2.4 ER 1110-2-1302, Civil Works Cost Engineering
- 2.5 ER 1110-3-1301, Cost Engineering Policy and General Requirements for HTRW Remedial Action Cost Estimates
- 2.6 TM 5-800-2, Cost Estimates -Military Construction
- 2.7 EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule-Region III
- 2.8 Architectural & Engineering Instructions for Design of Military Construction
- 2.9 Architectural & Engineering Instructions for Project Engineering with Parametric Estimating

3.0 DEFINITIONS:

3.1 Program Amount (PA) Total escalated amount of project funds authorized by Congress, or the customer, to be charged to construction (excludes II engineering and related project design cost). The PA includes the estimated construction contract cost and allowances for construction contingencies, supervision and administration, preparation of as-built drawings, engineering and design services during construction, and all other cost authorized by the directive or instructions to be charged to construction. Some typical "other" cost may include communication costs and costs that might be incurred by the Installation or using service to include furnishings, special equipment, troop labor, or similar related project costs. It is very important that the designer/cost engineer be aware of the PA and the various amounts and types of construction funds which comprise of the P/A, since the construction "contract" amount or construction cost estimate, plus all other allowances, must be within the PA.

3.2 Current Working Estimate (CWE)

The most current working estimate of the total projected project cost at a specific stage of design necessary to provide a complete and usable facility. It, like the PA, includes the estimated construction contract cost and all other allowances provided for in the PA. It is important to note that if portion of the work authorized by directive is to be accomplished by a future contract, by other means, or otherwise withheld from the final design, requests for bids or contract award, then a proper allowance for the cost of this work shall also be included in the CWE. The CWE is continually updated during the life of the project to reflect progressively more detailed levels of design effort which determine more accurately the expected final cost. The control CWEs are periodic checks on whether the project is over or under the PA/budget. Except at the initiation of project design, when the budget CWE is equal to the PA, it would be rare that the control CWE and PA are identical, although the control CWE should always be less than the PA.

3.3 Construction Cost Limit (CCL)

The amount of funds, based on the PA, actually available for construction contract award, i.e., the Program Amount less contingencies, supervision and administration, and other allowances. It establishes the ceiling for the Government Estimate (including escalation). If the GE should exceed the CCL, the project must be either redesigned, additional funds authorized, or bid additives, deductives, or options established. When the A-E negotiates the design contract it has accepted the responsibility for producing a design that will result in a project that can be awarded within the PA and CCL.

3.4 Government Estimate (GE)

A formal approved construction cost estimate prepared for contracting purposes. It represents the latest estimate of actual construction contract cost including escalation but excludes contingencies, supervision and administration and other allowances. An A-E prepared construction cost estimate does not become an "Official" GE until approved by NAO Cost Engineering; however, the A-E shall treat the A-E prepared cost estimate as a "For Official Use Only" document regardless of its approval status.

3.5 Primary Facilities

These are the main facilities (buildings/structures) in the project fulfilling the mission essential functions. The total estimated cost of primary facilities shall be estimated to include all construction costs (including earthwork) within a five-foot of the structure(s), commonly referred to as the "five-foot line". Each facility shall have a separate quantity take-off and the facility costs estimated as a separate primary facility. Identical facilities may share the same "quantity takeoff"; however (except for family housing), each structure shall still be identified in the MCACES cost estimate as a separate facility. Near identical facilities may also share the same takeoff with the takeoff for one (or more) referencing the detailed takeoff for the other and noting the quantity variations only.

3.6 Support Facilities

Includes all costs outside the five-foot limit. Support facility costs shall be taken-off and estimated separately for each associated primary facility. The construction cost of items which serve more than one prime facilities shall be included with the facility which is most critical to the project as a whole, i.e., least likely to be dropped from the project as a result of budget constraints.

3.7 Life Cycle Cost

The sum total of the direct, indirect, recurring, nonrecurring, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final position of a major system over its anticipated useful life span. Requirements for life cycle cost analysis are defined in the contract Statement of Work and/or AElS. The Architectural and Engineering Instructions specify which building systems require life cycle cost studies.

4.0 COST ENGINEERING FUNCTION

The cost engineering function in Norfolk District is the responsibility of the Cost Engineer, Engineering Support Section which reports directly to the Chief, Engineering Branch. Responsibility and accountability for all cost engineering is centralized in this section. It is directly accountable and responsible for all cost engineering services provided on all military, environmental restoration and civil works projects designed in-house or under A-E Services contracts. A-Es are responsible for cost engineering services in accordance with the contract Statement of Work (SOW) and the instructions contained herein. The contract SOW takes precedence over these instructions in the event of a conflict. Cost Engineering's review, comments and or acceptance of A-E prepared cost estimates does not waive the Governments rights with regards to the A-E's responsibility for providing current, complete, and accurate cost engineering services, or the A-E's responsibility to provide a design within the CCL.

5.0 SCOPE OF COST ENGINEERING SERVICES

5.1 Planning, pre-concept, concept, and final design cost estimates shall be thoroughly documented to explain the basis of the estimate and to include contingencies associated with any unknowns or risk factors. If a portion of the work authorized by directive, and included in the PA, is to be accomplished by a future contract, by other means, or, otherwise withheld from the concept or final design, invitation for bids (IFB) or contract award, a proper allowance for the cost of this "deferred" work shall also be included in the CWE.

5.2 Estimates shall be based on the most recent design and site information available, and shall follow the format of the appropriate Work Breakdown Structure (WBS) to the assembly level (Level 6). Strict adherence to the specified work breakdown structure cannot be overemphasized as estimates must be developed in the required format in order to export or, import between the various software applications. Deviations from the specified WBS structure may be permitted for special applications, such as unit priced contracts. There are three (3) separate Work Breakdown Structures, i.e., Military, Environmental Restoration, and Civil Works. The Military WBS shall be used for all vertical building construction whether Military Environmental Restoration or Civil Works funded. Environmental Restoration projects shall use the Hazardous, Toxic, Radioactive Waste (HTRW) WBS (funded by DERA, Superfund, DOE, etc). The Civil Works WBS shall be used for civil funded projects such as beach nourishment, pump stations and large earth moving/dredging projects normally funded with non-military funds. Any questions concerning the proper format, application or work breakdown structure shall be directed to the Chief, Cost Engineering Section.

5.3 The final design estimate shall reflect the expected cost to the Government for performing the work by contract and be prepared in the same careful manner as if the cost engineer were bidding in competition with prudent, experienced, and well-equipped Contractors. All reasonable costs which a Contractor might be expected to anticipate and include in his proposals shall be included in the cost estimate.

5.4 The estimate shall reflect the local labor market (Davis Bacon wage rates are a minimum) and material prices anticipated or forecast to prevail in the vicinity of the project at the time the project is scheduled to be constructed. Davis Bacon rates are available on the network at the following address:
<http://www.seals.usace.army.mil>.

5.5 The method used for preparing the estimate shall be in conformance with the requirements in section 6 below.

5.6 Should any question or clarification arise concerning procedure, the Norfolk District Cost Engineer Section shall be contacted for clarification. Phone (757) 441-7707.

6.0 COST ESTIMATING METHODS.

6.1 Tri-Services Automated Cost Engineering System (TRACES)

TRACES, comprised of several subsystems/modules provides a user friendly cost engineering platform, in a windows environment, with all the necessary subsystems and databases required to prepare, analyze, review and maintain all types of construction estimate and schedules. The U.S. Army Corps of Engineers currently mandates the use of some TRACES modules for specific cost engineering applications. Those subsystems currently on-line, including the applications which are mandatory, are described below. Estimates must be prepared following the specified WBS in order to facilitate the transfer of files between subsystems/modules. TRACES is available to A-Es and the Construction industry within the Construction Criteria Base (CCB) information system, which is available from the National Institute of Building Sciences, 1201 L Street, N. W., Suite 400. Washington D. C. 20005, (202) 289-7800; however, on request by A-E firm to the District Project Architect or Engineer (PA-E), Cost Engineering will furnish the latest version of any of the subsystems or databases not currently available in the CCB. In addition to the support databases (models, assemblies, crews, unit price book, labor and equipment) provided with TRACES, Norfolk District HAG created additional support databases, based on local conditions, which will be provided upon request to the District's PA-E (a list of available Norfolk District databases is included at Exhibit K). A brief overview of each subsystem/module and whether its use is mandatory for cost engineering services follows:

6.1.1 Micro-Computer Aided Cost Engineering System (MCACES)

A stand alone detailed cost estimating system with the ability to estimate costs by creating or incorporating pre-defined models, assemblies and crews; or, by drawing from a unit price book, labor and equipment databases. It is a complete and comprehensive estimating program for the preparation of detailed or parametric construction cost estimates. MCACES is mandatory and shall be used by all in-house and A-E cost engineers for all concept and final design cost estimates unless specifically exempted by the Chief, Cost Engineering. As of the publication of these instructions, MCACES Gold Version 5.3 is available on the CCB.

6.1.2 Parametric Building Models for Windows (PBMW)

This is a stand alone cost estimating system that uses pre-defined models and assemblies. The user has the ability to change or create models and assembly algorithms, and the added capability of transferring line items to and from a "quantity takeoff system", i.e., MCACES. The parametric cost estimating method is required for pre-concept design effort cost estimates on elected projects programmed for Fiscal Year '01 and later. The cost engineer has the option of using either PBMW or MCACES for this purpose. Parametric estimates are prohibited for concept and more advanced design submissions.

6.1.3 Historical Analysis Generator (HAG)

A stand alone system capable of collecting, manipulating, and extracting historical data. The HAG database for each project includes a description of building systems, the MCACES cost estimate, and bid results in the required work breakdown structure. HAG is not mandatory but is available for the cost engineer to compare current project costs with the estimate and bid results of similar projects. The requirement for following the specified WBS cannot be overemphasized. If the appropriate WBS is not followed, the MCACES or other subsystem cost estimate cannot be loaded/transferred into the HAG without major rework.

6.1.4 Life Cycle Costs (LCC)

A stand alone system capable of calculating the total cost of ownership (LCC) of one or more alternative (buildings, dams, etc.) facility systems (structural, mechanical, electrical, etc.), or components, and remedial clean-up efforts.

6.1.5 PC Cost (PCC)

A stand alone cost estimating system which utilizes the most general parameters (\$/SF). Used for preparing DD Form 1391 and ENG Form 3086. It will also convert MCACES and parametric (PBMW) estimates to 1391 and 3086 formats and upload estimates to II PAX mail system. This system is used by District cost engineers, i.e., not a requirement of A-E's.

6.1.6 Schedule Interface (SI)

A system capable of transferring from MCACES, title, labor, and precedent's to a commercial network analysis system. Not required.

6.1.7 Cost Engineering Dredge Estimating Program (CEDEP)

A stand alone system used to produce cost estimates for dredging projects, in a standard format, for pipeline, hopper and mechanical dredging operations. Not Required.

6.1.8 Risk Analysis (RA)

A stand alone system used to calculate cost estimating risks and determine needed contingencies. It has the capability to upload data from MCACES and includes a separate system for calculating contingencies factors for HTRW projects. A cost risk analysis shall be prepared for cost plus contracts and for contracts where quantities and or scope are not clearly defined. Next update is titled "Corps Risk", release date not scheduled.

6.1.9 Remedial Action Cost Engineering and Requirements System (RACER)

An U.S. Air Force developed parametric model, windows based system for programming HTRW projects. Required for project programming on U.S. Air Force HTRW projects. Optional for U.S. Army Corps of Engineers HTRW projects; otherwise, use MCACES or other cost estimating system approved by Chief, Cost Engineering.

6.1.10 HAZRISK

Risk assessment software for HTRW projects based on historical data.

6.1.11 HCAS -Historical Cost Analysis System

Database of completed HTRW projects to include cost associated with studies, design, remedial action and operations and maintenance related cost.

6.2 Manual Method of Cost Estimating

The manual method is rarely utilized anymore; however, if proposed for an NAO project, it shall be approved, in writing and in advance, by the Chief, Cost Engineering. Be advised that this is an exception rarely approved. When the manual procedure is approved for a project or specific submittal of a project, the estimate shall be prepared organized, and formatted using the appropriate TRACES template and work breakdown structure, i.e., Military, Civil, HTRW, etc. The estimate shall be prepared utilizing the appropriate forms prescribed in TM 5-800-2. At the ready to advertise submittal, the estimate forwarded to the Norfolk District shall be the original prepared in pencil, in order that any necessary revisions by the Government may be readily incorporated.

6.3 Excel Spreadsheet Method of Cost Estimating

The spreadsheet method is also rarely approved; however, if proposed for an NAO project it shall be approved, in writing and in advance, by the Chief, Cost Engineering. Be advised that this is a rare exception. When the spreadsheet procedure is approved for a project or specific submittal of a project, the estimate shall be prepared, organized, and formatted using the appropriate TRACES template and work breakdown structure, i.e., Military, Civil, HTRW, etc. The format shall be for a "detailed" estimate to include, as a minimum, labor and equipment hours, rates and extended costs, and material quantities, unit and extended costs. Where appropriate, i.e., unit pricing/cost data is not available in Government or commercial estimating guides, lump sum amounts may be used. At the ready to advertise submittal, the estimate forwarded to the Norfolk District shall include the Excel file on floppy diskette, in order that any necessary revisions by the Government may be readily incorporated.

6.4 R.S. Means Based Cost Estimates

Construction contracts available to NAO for project execution include some hybrids where the contract, delivery order or job order price will be based on the R.S. Means construction cost database with certain area cost or other multiplication factors. These type contracts are generally used on small projects. The A-E should determine from the PA-E if the proposed project has been identified for procurement by one of these contracts before commencing the estimate. NAO uses the software application "Pulsar" for preparing cost estimate for these projects. A copy will be made available to the A-E on request. A-E prepared cost estimates for these projects may be prepared using either Pulsar or a similar software application which utilizes the complete R.S. Means construction cost database. The A-E may also prepare the cost estimate from R.S. Means cost guides, i.e., to include the Sitework & Landscaping, Heavy Construction, Interior, Plumbing, Mechanical, Electrical and/or other appropriate R.S. Means cost guides. See detailed instructions below. The A-E should contact NAO Cost Engineering to determine the specific contract requirements regarding contractor mark-ups and or multiplication factors. The Means based cost estimate for these projects need not follow the normally specified work breakdown structure.

For non-Means based software generated cost estimates, the cost estimate shall be presented in the Means format utilizing identical line item numbers, descriptions, columns and cost data. This procedure facilitates the negotiation process since the contractors proposal will also be presented in the Means format. There will be no detail item title changes or adjustments for direct costs associated with labor rates, production, equipment or material costs. Should it be necessary to create/add a line item for work not covered by Means, the cost engineer will create a line item number near a similar work item number and clearly identify all "created" with an "M" at the end of the number. The estimate shall be organized in accordance with the CSI format and contain sufficient titles/descriptions to allow a second party to easily make connection between the quantity takeoff and cost estimate.

7.0 COST ENGINEERING PERSONNEL REQUIREMENTS AND TRAINING

7.1 Personnel Qualifications

The designers cost estimating staff shall consist of dedicated full-time cost engineering specialist(s) for each required design discipline, such as architectural, structural, civil, mechanical, electrical, fire protection, corrosion engineering, etc. It is imperative that estimates be prepared and reviewed under the direct supervision of personnel who are competent in construction cost estimating. Estimators must possess a working knowledge of construction and be capable of making professional judgments based on experience. If the designer determines his staff does not possess all these qualification, he shall obtain assistance from a qualified firm whose specialty is cost estimating. Estimates prepared by a consultant must be reviewed by the designer before submission to insure accuracy, completeness, coordination and compliance with these instructions, and the contract SOW. A-Es shall assure that cost engineer's have access to and are trained in the required computer hardware and software applications required to accomplish the cost engineering function. Where applicable, this includes life cycle cost analysis, cost risk analysis and parametric estimating techniques.

7.2 Training

The Corps of Engineers and software vendors sponsor training in the required systems. Corps sponsored training classes are also available to A-E firms. A-Es are encouraged to utilize either Corps or vendor training where necessary to ensure satisfactory performance in the cost engineering function. The required software systems are complicated requiring either formal training or extensive practical experience to achieve an acceptable level of proficiency. Unless cost engineers proficient in the systems are used, submittal delays and re-submissions as a result of estimating errors are very likely.

8.0 GENERAL INSTRUCTIONS

8.1 Additional Instructional Publications

Cost estimates for all construction projects shall be prepared in accordance with the instructions and exhibits contained in this A-E Services Manual, TM 5-800-2 "Cost Estimates – Military Construction" and applicable TRACES Subsystem/Module User Manuals.

8.2 Cost Estimate Overruns

It is the A-E's responsibility to design the project for a Current Working Estimate (CWE) that is equal to or less than the Programmed Amount. And, to insure an awardable project within available funds, the Base Bid CWE shall be based on 95% of the CWE, providing a 5% cushion in the event the estimate is determined to be low at bid opening. The remaining 5% shall consist of Additives, Deductives, Options, etc. The proposed additives, deductives, options, etc., shall be identified at the concept design level and included, both in the quantity take-off and the cost estimate, as separate bid items accordingly. Should the project CWE exceed the programmed amount, the A-E shall provide a written narrative explaining the reasons why the CWE exceeds the programmed amount and offer proposals which would reduce the CWE within available funds. A written narrative shall also be submitted whenever the current estimate has changed more than 5% (plus or minus)

from the previous estimate. In the case of concept estimates, variations of 5% from the DD Form 1391 shall be explained in narrative form.

8.3 Failure to Comply with Procedures

Failure of the A-E to conform to the procedures contained in this and referenced manuals will result in the estimate being rejected and resubmitted with the deficiencies corrected. If time is a critical factor, the A-E may be required to visit the District office within 48 hours for a face-to-face meeting and may be required to furnish a corrected cost estimate before leaving the District office.

8.4 Cover Sheet - Checklist

THE CHECKLIST SHOWN IN EXHIBIT A, "COST ESTIMATE SUBMITTAL CHECKLIST" SHALL BE COMPLETED AND USED AS THE COVER SHEET FOR EACH COST ESTIMATE SUBMITTAL. Failure to complete and transmit this checklist will result in the estimate being returned.

8.5 Safeguarding the Cost Estimate

Due to the sensitive nature of the estimate, access upon consolidation of various components and features of work shall be restricted. The number of employees having such knowledge shall be kept to a minimum, consistent with good management. Upon commencement of work in the construction cost estimate, the A-E shall prepare NAO Form 5 and shall use that form as the next sheet under the cover sheet (checklist) for the estimate. Reference sample NAO Form 5 at Exhibit B "Control Record For Government Estimate." Entries shall be made on the form in the appropriate spaces to show the date and name of each person having comprehensive knowledge of the estimate. When the work has progressed to a point where the information may be indicative of the overall costs, the estimate sheets, when not being worked on, shall be kept in a locked container. NAO Form 5 shall be transmitted to the Norfolk Office with the estimate. The estimate shall be transmitted through the mail or hand delivered in double envelopes. The inner envelope shall be plainly marked as follows, for example:

Government Estimate for Project: 025519

WHOLE NEIGHBORHOOD REVITALIZATION OF 114 FH UNITS
FORT MONROE, V A

NOT TO BE OPENED IN MAIL ROOM FORWARD TO COST ENGINEERING

In addition, a letter of transmittal or endorsement shall be affixed to the inner envelope. Nowhere in that letter shall there be a statement as to the monetary amount of the estimate. The outer envelope shall be of sufficient opaqueness and density to prevent markings on the inner cover from being visible and shall be addressed, return addressed, and carefully sealed with no markings or notations to indicate the identification of the contents.

8.6 Estimates With More Than One Line Item

When the A-E's design contract includes more than one "Line Item Number," preparation of a separate detailed cost estimate and associated summaries for each line item is mandatory on all submittals. Site work associated with each line item shall also be estimated separately. This procedure facilitates the separation of cost in the event that a line item is deferred into another fiscal year or another program/project/bid package, etc.

8.7 Proposed Bid Schedule

8.7.1 Bid Schedule

The A-E shall submit a proposed bid Schedule, see Exhibit G, with each final and corrected final submittal. This schedule shall list all primary and support facilities separately.

8.7.2 Additives, Deductives, and Options

When either additives, deductives or options are being considered, first consult with the PA-E to determine the most advantageous to the Government or User. There are certain FAR requirements that have to be followed in the award process that causes one to be more advantages than the other under certain conditions. A clearly defined (detailed) Scope of Work statement shall be included in the contract specifications, on the drawings or both for each additive/deduction/option to insure that all contractors are bidding on the same basis and to preclude varying interpretations between the Government and construction contractor concerning the scope of base bid and or alternates during construction. The "alternate" scope definition shall also be reproduced and provided to each cost engineer (for take-off and estimating purposes) and submitted to NAO with the proposed bid schedule for review purposes.

8.7.3 Multiple Funding Sources

It may also be necessary to breakout items of different funding sources. The NAO PA-E should be contacted in regards to this requirement. As with alternate bid items, a clearly defined (detailed) scope of work statement shall be included in the contract specifications, on the drawings or both for bid items covering different funding sources to insure that all contractors are bidding on the same basis, and to preclude varying interpretations between the Government and construction contractor during construction.

8.7.4 Unit Price Schedules

In addition, some project or features of work shall be bid using a unit price schedule. Unit price schedules provide valuable feedback as to the current pricing in that area for various features of construction and facilitates change order negotiations during construction. When unit prices are required, an associated bid quantity shall also be provided and the unit price extension factored into the determination of low bid; otherwise, contractors will propose higher unit prices. The contract specifications shall clearly define what elements/costs are to be included with each unit priced item, to insure that all contractors are bidding on the same basis and to preclude differences in scope interpretations during construction, for payment purposes and change order negotiations. The following guidelines shall be used to determine when unit prices are applicable, but it is also recommended that NAO Cost Engineering be consulted prior to initiating the quantity take-off should there be any questions in this area:

8.7.4.1 Projects for which the scope of work is principally utility (water, sewer, storm, steam & condensate, gas, power & communications distribution, etc).

8.7.4.2 Projects for which the scope of work is principally highway construction (new road construction or resurfacing contracts).

8.7.4.3 Projects for which the scope of work involves significant earthwork construction.

8.7.4.4 Projects for which the scope of work involves significant site concrete construction.

8.7.4.5 Projects which include paved areas in excess of 3,000 SY of either asphalt or concrete pavement shall include unit price schedules for pavement areas, by pavement section design (thickness, pavement type, etc.).

8.7.4.6 Projects for which the scope of work is principally lead, asbestos or other abatement shall include a unit price schedule for each separately definable feature, i.e., size of pipe, area, type of material being abated, etc. A project which includes incidental lead and asbestos abatement shall have separate lump-sum bid items for asbestos, lead or other abatement work, i.e., unit prices not required.

8.7.4.7 Pile driving work shall always be bid unit price.

8.7.4.8 Rock excavation shall always be bid unit price.

8.7.4.9 Where over-excavation and additional backfill may be required, in connection with questionable subgrade materials, an estimate of the quantity of overrun only shall be made and bid as a unit priced item within the total bid amount, i.e., not as a separate unit price without an associated quantity identified. Without a quantity, the unit price cannot be factored into the total bid amount, thereby inviting contractors to propose higher unit prices.

8.7.4.10 Re-roofing shall always include unit priced items for which the anticipated quantities are not clearly defined, i.e., an unknown amount of underlying insulation, wood and gypsum deck repairs, asbestos containing asphalt sheets, etc.

8.7.4.11 Other projects or feature of a project where the quantity of material or scope of work cannot be firmly established in the plans and specifications prior to bidding, or where certain features of work are expected to overrun or underrun.

8.8 Design Stage Identification

All sheets of the cost estimate shall be clearly marked as to the design stage (study, pre-concept, concept, preliminary, final, corrected final, etc.). The quantity take-off sheets shall be dated with any subsequent revisions annotated by date and initials. The design stage identity shall be entered in the "REPORT TITLE" field of the "PRINT SELECTED REPORTS" entry screen from the Report Menu of MCACES Software.

8.9 Copy Requirements

The summary and detailed cost estimate and all other exhibits and/or information required by this or referenced manuals/instructions shall be submitted in sealed envelopes directly to Chief, Cost Engineering, Norfolk District in duplicate (unless the contract SOW specifies otherwise) on 8-1/2" x 11" bound sheets. Only one copy of the quantity take-off sheets need be submitted. It shall be organized by discipline and transmitted in a manner that will facilitate separation by discipline for review purposes. Too often the cost estimate is transmitted without the take-off. The take-off is extremely valuable to the reviewer as it precludes our in-house cost engineers from having to perform redundant and separate take-offs to verify selected quantities. It also serves as a valuable tool when conducting VE studies. Due to time constraints, and the need to minimize review costs, the cost estimate will not be reviewed without the take-off and the omission of the take-off from the submittal will result in delaying the review process. This requirement includes all submittal levels, including cost estimates for construction contract modifications. Electronic copies (floppy diskettes) of the project and supporting databases shall also be provided for all submittals and transmitted in the same envelope. The databases shall be saved by the "SAVE TO COMPRESSED" method from the SERVICES menu of the MCACES Software. Access to all the databases allows NAO cost engineers to directly incorporate design changes, and corrections necessary to establish the CWE reported to higher command or addendum's prior to bid opening when there is insufficient time for returning the estimate to the A-E for this purpose.

8.10 Budgetary

The budgetary data furnished the A-E is not to be considered restrictive, i.e., if the project scope of work, site conditions and design criteria result in a CWE in excess of the PA, and the A-E has not exceeded either, the A-E would not generally be responsible for resultant redesign efforts. The A-E is responsible for providing an economical design in the development of the site, structures and systems as well as the functional arrangements necessary to satisfy the scope of work, comply with the design criteria and user requirements for the project. Should the budget however be exceeded as a result of choosing poor economical systems, exceeding the scope or design criteria in general, the A-E shall be responsible for redesign without compensation. The District shall be notified of any proposed changes in project scope or design criteria as soon as the need for the change has been firmly established.

8.11 Construction Schedule

A construction schedule shall be submitted in accordance with TM 5-800-2 with each cost estimate submittal. The construction schedule shall be prepared in accordance with current construction practices consistent with the requirements of the plans and specifications. The plan shall include the full period from the beginning of mobilization to and including submittals, construction, cleanup and final acceptance of the work by the Contracting Officer. An example of a plan of construction is shown on page D-7 of TM 5-800-2.

8.12 Quantity Take-off-General

8.12.1 Safeguarding

The quantity take-off, like the cost estimate, shall be treated in a confidential manner and only those personnel concerned with the preparation and/or review of the project shall have access. The take-off will be classified "FOR OFFICIAL USE ONLY." Such material cannot be divulged to other than accredited Government personnel with a need to know. Information contained within estimates shall not be divulged to prospective bidders.

8.12.2 Accuracy

The importance of an accurate and concise quantity take-off for the estimate cannot be overstressed,. The quantity take-off for each bid item, except as defined herein, shall follow one of the following Work Breakdown Structures (WBS).

8.12.2.1 Military WBS

Description. Except as provided herein, the Military WBS to Level 6 as provided in MCACES shall be used on all Military Construction Projects. This Military WBS is a hierarchy structure comprised of six levels: 1) Primary/Supporting Facility; 2) Facility; 3) System; 4) Subsystem; 5) Assembly Category; 6) Assembly, and followed by line item detail. Each system is divided into one or more subsystem which are further divided into assembly categories, then assemblies. Assemblies are made up of construction line items. The System, Subsystem, and Assembly Category Titles are rigidly defined and shall not be changed. Level 1 (same Level as Project Information Record) shall not be changed, i.e., two titles, Primary Facilities and Secondary Facilities.

Exception. The only exception to strict adherence to the specified WBS is in the development of unit price bid items, where the cost of an item might be spread over several systems, subsystems, assemblies, etc. and Means based cost estimates described in paragraph 6. Therefore, for some unit price items, it may be necessary to deviate somewhat from the WBS in order to capture all cost associated with that item under the appropriate bid item title. For example, a deep sewer utility project consisting of various size sewer pipes would include all cost associated with excavation, backfill, dewatering, shoring and laying pipe under each of the separate titles for each 8", 10", 12" pipe size, etc. For significant projects it will be necessary to further divide these titles into subtitles to account for varying materials and depths, i.e. 8" PVC Gravity 8' to 10' deep; 8" PVC 10' to 12' deep; 8" D.I. Force Main 8' to 10' deep; 4' Diameter Manhole, 8' to 10' deep; etc.

WBS Guidance. Each building/structure support facilities, unit price item or bid alternate shall be taken off separately and defined at title level 2 in the MCACES estimate. By utilizing the separate building and support system take-off procedure it would be easier for Norfolk District or the A-E, if necessary, to separate from the Base

Bid the appropriate quantities and cost associated with unit price and Alternate bid items that might be identified late in the project Common support facilities shall be included with the building least likely to be identified as an additive, deductive or optional bid item. In no case, except for unit price items, shall the WBS title descriptions be changed for levels three through five. New titles for Subsystems or Assembly Categories shall be entered under the "Other" category. See the Military WBS. Note that the 01 through 15 Systems are for the interior of the building (5-foot line outside the building) and System 16 Selective Building Demolition fall under Primary facilities. Systems 17 through 20, are exterior systems and fall under Support Facilities. For projects bid almost entirely by unit price, the A-E will likely have to revise the military WBS in order to create a WBS tailored to the proposed bid schedule. Consult with NAO Cost Engineer first.

8.12.2.2 HTRW Projects

HTRW (Hazardous, Toxic, or Radioactive Waste) Environmental Restoration Projects shall use the HTRW WBS. The HTRW WBS provides the framework for preparing cost estimates, modeling development, and collecting historical data for all remediation projects. The WBS consists of a numbering and title system that details the work to four levels of the WBS to organize the HTRW estimate. The quantity take-off shall be prepared following the WBS to the same level. In no case shall the WBS title descriptions be changed for levels one through four. Levels five and six shall be created to further break down systems of work into Assembly Categories and Assemblies, respectively. New titles for work not covered in the WBS may be added under numbers 90 through 99. Maintaining this rigid structure for the first four levels will allow systematic collection of historical HTRW costs. Any vertical building construction required within the HTRW project shall be a separate estimate from the environmental work and shall follow the Military WBS. HTRW projects will likely have two distinct phases; construction of a treatment facility and operation and maintenance of the facility over a period of time that may range from months to years. Construction and operation wage rates, escalation rates, and other cost may be different for construction vs. long-term plant operation. Therefore, construction cost will be prepared in a separate estimate from the "after construction" operations costs. Depending on the project scope, it is possible the A-E will be required to prepare three (3) separate estimates for each submittal. One for the vertical building construction, one for the HTRW construction, and one for plant operations.

8.12.3 Assemblies

An Assembly is a collection of individual cost items that function together as a single building/construction unit. For example, a 300 mm (12-inch) storm drainage line consists of excavation, backfill, compaction, layer of drainage gravel/bedding, 300 mm (12-inch) concrete pipe, etc. One unit of assembly contains a specified quantity and unit of measure of each included item. The Assembly has its own unit of measure. When the assembly is "linked" and the assembly quantity is changed, all included item quantities are changed proportionately. Assemblies shall be created for building/construction systems as required by the project.

9.0 DETAILED INSTRUCTIONS FOR QUANTITY TAKE-OFFS.

9.1. General

The following procedures and exhibits must be followed in order for the A-E to present an acceptable quantity take-off and estimate. If a spot check of quantities by the District reveals inaccuracies, or the required WBS format has not been used in the preparation of the estimate, the estimate will be ejected and returned for resubmission with the deficiencies corrected.

9.2 Organization

Organization of Quantity Take-off is extremely important. It is essential that the take-off be started and organized based on the anticipated bid schedule, type of funds and the required Work Breakdown Structure; otherwise, much time will be lost attempting to transfer take-off quantities to the appropriate cost estimate bid item, primary or support facility, system, subsystem, assembly and detail item. The lead cost engineer, in coordination with the project manager, architect, and lead engineers must begin the take-off process by becoming thoroughly familiar with the WBS, then setting up the required MCACES Project Database title structure, i.e., one that will result in satisfying requirements to produce the estimated cost for each separate lump-sum and unit price bid item for each primary and support facility, different funding sources, additives, deductives and or options. Distribute this title structure in hard copy or electronic format to all cost engineer disciplines involved in the take-off and cost estimate. Unless you start in this manner you will face some real challenges later in trying to merge or otherwise

consolidate the individual discipline take-off or cost estimates. It is recommended that, until you become highly proficient with the required WBSs that a hard copy of WBS be used as a guide during the take-off phase.

The A-E may prepare his quantity take-off on DA Form 5421-R, Construction Cost Estimate Worksheet or similar industry standard forms. NAO has developed In-house quantity take-off forms for this purpose. Any blank forms can be provided on request but must be copied as required by the A-E. Quantity take-offs shall not be written and submitted on the drawings. The quantity take-off shall be prepared in a manner that is clearly legible, indicating the calculations involved in determining the quantity and any assumptions the cost engineer has made in determining the quantity. The take-off shall contain back-up or supporting sheets, if necessary, to support the breakdown of all material quantities contained in the design drawings and specifications.

9.4 Quantity Take-Off Sheet Heading

The top of each quantity take-off sheet shall contain the following information: 1) project information; 2) the design stage; 3) the plate number and/or specification number from which the quantity was derived; 4) facility name, quantity, and UOM; 5) WBS assembly code where the quantity should be located in the cost estimate; 6) the date and signature of the cost engineer who prepared them as well as the initials of the cost engineer who checked them.

9.5 Quantities at Five-Foot Line

The quantity take-off for each building and/or structure shall include quantities of materials to a line 5 feet outside the building line. Include site preparation and grading for the building area within this line. Include all cost outside the five-foot line in Support Facilities in the appropriate subsystem.

9.6 Earthwork Quantities

Compute earthwork quantities for site grading, roads, drives, utilities, etc., by the methods of cross sections or end area, or by utilizing software specifically designed for this purpose. For large earthmoving projects, cross sections, etc. for earthwork quantities shall be prepared and submitted with the quantity take-off sheets at concept, preliminary and final design submittal. For minor earthmoving projects, describe method and show calculations for cut and fill quantities. Copies of the cross sections shall be submitted with the concept and preliminary designs, while the originals will be submitted with the final design submittal.

10.0 DETAILED INSTRUCTIONS FOR DETERMINING APPLICABLE WAGE RATES

10.1 Wage Rate Calculations

Guidance for wage rates to be used in preparing the construction cost estimate will be provided to the A-E by Cost Engineering, Norfolk District. The rates will reflect the most current Davis Bacon wage decision. Either the current Davis Bacon wage rates or current prevailing wage rates, whichever is greater, shall be used. The wage rate database provided will reflect the most current Davis Bacon hourly rate for the specific installation and includes most wage classifications and basic labor mark-ups for workman's compensation, taxes, insurance and benefits for a 40-hour construction week. It does not however include some highly specialized wage classifications nor does it take into consideration any abnormal circumstances such as a short term shortage of manpower in a specific trade in a local market which may have driven up rates, working in secure area, working in hazardous waste areas, or construction schedules requiring overtime or shift work, etc. The A-E shall be responsible for adjusting wage rates where appropriate and addressing any abnormal circumstances required by the project or local market and making corrections to the database rates provided, reference Chapter 7 of TM 5-800-2. Insurance and taxes on direct labor could range between 25% and 40% or higher depending on project location and discipline.

10.2 Wage Rate Modifications

If the project requires that the A-E make changes to the Labor Database provided, the A-E shall use the copy command from the "SERVICES MENU" to copy the Labor Database provided to a new Labor Database for this specific project. The identification of the new Labor Database shall match the six character code of the project ID. The New Labor Database can then be edited to reflect required changes to wage rates. An explanation of changes to the Labor Database shall be entered in a separate paragraph under PROJECT NOTES – titled

EXECUTIVE SUMMARY. A printed copy of the wage rates used in the project will accompany the submission of each estimate. If a new Labor Database is created, it shall be saved when saving the project database to compressed floppy diskette and transmitted with the formal submittal with the formal submittal.

11.0 OBTAINING EQUIPMENT/MATERIAL QUOTES

Formal (written) or informal (telephone call memo) price quotes (preferred) or budget quotes shall be obtained on all principal items of equipment (such as cranes, elevators, kitchen equipment, pumps, compressors, unit heaters, air conditioners, fans, transformers, switchgear, etc.) and any specialty items (such as glazed acrylic canopies, metal pan ceilings, etc.) and all other large dollar items in the estimate and submitted as part of the estimate backup. These price quotations shall include a sufficient description (size, capacity, etc.) of the item for evaluation purposes, the name of manufacturer, the date and the name, address, and phone number of the company supplying the quote. Price quotations shall contain the name of the company representative who supplied the quote and the time range for which the quote remains valid. A copy of all quotes/memos used to obtain pricing information shall be attached to the construction cost estimate.

12.0 DETAILED INSTRUCTIONS FOR DETERMINING INDIRECT COST OR FIELD OVERHEAD AND HOME OFFICE OVERHEAD

12.1 Prime Contractors Field Office Overhead Mark-Up.

Indirect costs are divided into two categories, Field Overhead and Home Office Overhead (G & A). For field office overhead, the calculated (itemized breakdown) method of determining field overhead is required. A generic itemized field overhead model is contained in the model database and shall be used as a starting place for the A-E. The A-E shall edit the itemized overhead model to fit the specific project. It is essential that Division 1000 specification requirements be factored into field overhead requirements, i.e., requirements for Supervision, QC, Scheduling, As-Builts, Project Signs, Temp Utilities, Safety, Portable Toilets, Trailers, Clean-Up (include dumpsters and disposal fees), Site Survey/Layout, Vehicles, etc. Items not applicable to this project shall be deleted and new items shall be added as required. See Exhibit C for MCACES instructions.

12.2 Subcontractor's Field Overhead.

A subcontractor's field overhead usually bears a fairly direct relationship to the subcontractor's portion of the work and can be estimated on a percentage basis. However, detailing of subcontractor's field overhead costs will be required for very large projects, where the subcontracted work has unique requirements, or where the cost impact of the subcontracted item is 25% or more of the total project direct cost. These percentages shall be used to determine when itemized overhead on subcontracted work is required and in assigning the weighted guide line factors to the Contractor's profit.

12.3 Typical Field Overhead Items.

TM 5-800-2, APPENDIX E, lists typical items of indirect costs. This list is to be used as a guide for evaluating particular project requirements along with the Generic Itemized Overhead Model provide.

12.4 Prime and Subcontractor's Home Office Overhead.

Home office costs are typically included in Government estimates as an average experienced percentage rate of the expected contract amount. It is important to understand that home office costs are not standard and fixed. The rate for a specific contractor varies from period to period. It is a function of total home office costs divided by the total volume of business during a specific period. A reasonable range of rates for general contractors subcontracting a large percentage of the work may average for estimating from 2% for larger to 7% for smaller contracts. A specialty subcontractor performing most of the subcontracted work will experience a higher G & A rate, from 8% for larger to 15% for smaller contracts. The amount of G & A is computed by multiplying selected percentage by the sum of the total direct cost plus field overhead. The Home Office Overhead shall be entered in the "Home Office Percent" field on the same entry screen.

13.0 DETAILED INSTRUCTIONS FOR DETERMINING PROFIT

Allocation of Profit in Cost Estimates. The estimate will include allowances for prime contractor and subcontractor profit. For the prime Contractor and major subcontractors the rates for profit shall be determined by the weighted guideline method. Page D-9 of TM 5-800-2 is an example of the profit factor sheet. The applicable factors for use in preparing this form are shown as Exhibit F. The reason for the A-E selecting each factor shall be determined in the " Notes" of each Contractor.

14.0 DETAILED INSTRUCTIONS FOR DETERMINING BOND

The costs of performance and payment bonds will be included in the estimate. The rates shall be calculated using Class B bond. See Exhibit C for setting instructions. No bonding shall be included for subcontractors.

15.0 DETAILED INSTRUCTIONS FOR DETERMINING SUBCONTRACT WORK**15.1 Use of Subcontractors In Cost Estimate**

Estimates will be prepared for subcontractor work using the same methodology and degree of detail as outlined for the general contractor. The cost of subcontracted work is the amount charged by the subcontractor for the work performed, including costs for direct labor, materials, equipment, and second tier subcontracts as well as his charges for overhead and profit. The list of subcontractors indicated on the sample estimate and shown in TM 5-800-2 at APPENDIX D are for illustration only. Project Templates supplied by NAO include IDs use to identify subcontractors in the "Contractor Settings" screen under the Project Information Record title.

15.2 Use of Subcontractor Quotations

The Government Estimate will be prepared initially independent of subcontract quotes. When subcontractor quotes are obtained and validated, they may then be used to verify the reasonableness of the estimated subcontract work.

16.0 SUBMITTAL REQUIREMENTS:**16.1 Pre-concept Submittal Requirements****16.1.1 Code 3 –Pre-Concept Design Program.**

16.1.1.1 The Code 3 Design Program (implemented for selected projects) will accelerate project design, intensify customer involvement, and produce a more accurate project budget utilizing parametric cost estimating techniques. It has been selected for application on certain types of suitable projects, such as those utilizing standard designs. The goal of Code 3 is to produce an accurate project definition which will result in a functional, durable, economical and safe facility that meets the requirements of the customer, within pre-defined budget constraints and supported with a parametric estimate that can be submitted quickly to Congress using minimum funds. Once a project is approved it proceeds directly to final design (no pre-concept, concept or early preliminary designs). Reference Architectural and Engineering Instructions for Project Engineering with Parametric Estimating.

16.1.1.2 On receipt of the Code 3 Directive a design team, including cost engineer(s), is assembled for the purpose of defining project scope and cost. The customer is also very much involved in this process. The cost engineer's role in this programming phase is twofold; 1) to provide quick cost estimates of the various alternatives that the team might consider while defining the final project scope; and; 2) to provide a final budget estimate. The cost engineer(s) involved in this process must be senior, i.e., with a thorough knowledge of parametric cost estimating and costs of various types of construction on a unit price, square foot or systems basis, in the vicinity of the project. Cost engineering requirements for this submittal will be defined in more detail in the scope of work.

16.1.2 Other Pre-Concept Level Study/Design Submittals. The pre-concept estimate shall be an MCACES or PBMW estimate, and the format of the estimate shall conform to the appropriate Work Breakdown Structure. The pre-concept estimate will generally be used to compare life cycle cost or first cost of a number of alternatives prior to proceeding to concept design.

16.2 Concept/early Preliminary (35%) Design Submittal

16.2.1 Concept Estimate. The concept estimate shall be an MCACES estimate and the format of the estimate shall follow the appropriate Work Breakdown Structure, proper allowances/contingencies shall be made for WBS systems and subsystems not completely defined in the concept drawings, outline specifications or design analysis.

16.2.2 Plan of Construction. Provide a preliminary Plan of Construction that is consistent with the requirements of the specifications and in accordance with current construction practices. See sample plan on page D-7 of TM 5-800-2 for further instruction on the preparation of this plan. Whether the plan is prepared by the cost engineer or others is optional to the A-E firm.

16.2.3 Funds. The concept estimate will be used to determine if the proposed design is within the amount of funds programmed for the project, and, if over budget, if redesign will be required, a reduction in scope required, or if the customer must pursue additional funding. Frequently these funds, once appropriated, cannot be increased. It is, therefore, imperative that this estimate include costs for every item that will be in the project, or a contingency amount provided for items not clearly defined at this point in the design. The A-E must be absolutely certain that the project can be built for the CWE developed from the concept estimate. During the concept design period, close cost control, consisting of coordination between designer and cost engineer, shall be exercised to achieve an accurate estimate.

16.2.4 Corrected Concept Cost Estimate. Corrected concept cost estimates will generally be required to incorporate cost engineering review comments and scope changes occurring during the review process. The A-E shall submit a corrected concept estimate if any design or other revisions have been made effecting scope of bid items or project cost. This estimate shall be prepared utilizing all the above described instructions and incorporating all the corrections, revisions, review comments, etc. All changes to the estimate shall be described and identified in the PROJECT NOTES. This estimate will be submitted in duplicate.

16.3 SIXTY- PERCENT (60%) DESIGN SUBMITTAL REQUIREMENTS

The sixty percent requirements for preparation of cost estimates are the same as the requirements listed below for the preliminary (60%) Design Submittal Requirements.

16.4 Preliminary (60%) Design Submittal Requirements

16.4.1 General. Cost estimates for all construction projects shall be an MCACES type estimate generated by "MCACES" Software and prepared in accordance with instructions contained herein. Proper allowances shall be made for WBS systems and subsystems not completely defined in the preliminary drawings, outline specifications or design analysis.

16.4.2 Preparation. The cost engineer shall show all assumptions as to scope and design used in the preparation of the estimate.

16.4.3 Principal Equipment. In addition to the quantity take-off, the A-E's shall submit a list of the principal items of equipment and source of pricing (such as cranes, elevators, kitchen equipment, pumps, compressors, unit heater, air conditioners, fans, etc.), indicating the name of manufacturers and positive identification of items selected.

16.4.4 Evaluation. Special attention shall be given to the evaluation of the item General/Prime Contractor's Indirect Costs.

16.5 Final (100%) Design Submittal Requirements

16.5.1 General. Final design cost estimate for all construction projects shall be a MCACES type estimate generated by MCACES and prepared in accordance with instructions contained herein and in accordance with Exhibits A through L of this manual.

16.5.2 Plan of Construction. Provide a final Plan of Construction in accordance with that is consistent with the requirements of the specifications and in accordance with current construction practices. See sample plan on page D-7 of TM 5-800-2 for further instructions on the preparation of this plan. Whether the plan is prepared by the cost engineer or others is optional to the A-E firm.

16.5.3 Quantity Take-Off. A complete and detailed quantity take-off and accompanying cost estimate shall be submitted with the final design. The quantity take-off and cost estimate shall be an accurate representation of the completed design submitted.

16.5.4 Principal Equipment. In addition to the quantity take-off the A-E's shall submit a list of the principal items of equipment and source of pricing (such as cranes, elevators, kitchen equipment, pumps, compressors, unit heaters, air conditioners, fans, etc.) and any specialty items (such as glazed acrylic canopies, metal pan ceilings, etc.) indicating the name of manufacturers and positive identification of item selected. Price quotations on all items listed above and on all other large dollar items in the estimate will be submitted as part of the estimate backup.

16.5.5 Indirect Field Overhead Costs. An itemized detailed list of field overhead costs shall be part of the final design estimate.

16.5.6 Profit Weighted Guide. The A-E shall use the profit weighted guide to prepare a detailed profit for the prime Contractor and major subcontractors.

16.5.7 Draft DD Form 1354. If required by SOW provide a draft DD Form 1354.

16.6 Corrected Final Design Submittal Requirements

16.6.1 Notice. Corrected final submittals are not considered a normal design level and are required only when final submittals must be revised or corrected due to error or omission.

16.6.2 When To Submit. The A-E shall submit a corrected final estimate and bid schedule if any design or other revisions have been made effecting scope of bid items or project cost. This estimate shall be prepared utilizing all the above described instructions and incorporating all the corrections, revisions, final design comments, etc., made to the design since the final design submission. All changes to the estimate shall be described and identified in the PROJECT NOTES. This estimate will be submitted in duplicate with the corrected final design-submittal.

17.0 CWE SUMMARY CALCULATIONS REPORT

17.1 Preparation of CWE Summary Calculation Report. Exhibit E shows example of the format for a CWE Summary Calculations report. This summary report shall be prepared for all concept, preliminary, final and corrected final submittal. The report shall be completed in accordance with instructions contained below.

17.2 Price Level. Use a price level of present day contract costs. The cost summary shall be escalated to the midpoint of construction. Army and/or Air Force escalation factors will be provided by the Cost Engineering Section.

17.3 Estimated Construction Time. The estimated construction time, in calendar days, for the total project shall also be shown. Calendar days are entered in the "EST CONSTRUCTION TIME" field of the "REPORT TITLE PAGE" screen from the REPORTS Menu.

17.4 Contingencies. Exhibit E shows Contingencies at 5% of the Escalated Contract Cost, SIOH at 6% of the subtotal of the Escalated Contract Cost and Contingencies of the Escalated Contract Cost (ECC). The percentages vary from program to program and are subject to change. Currently the SIOH rate for MCA funded projects is 5.7%. All OMA funded projects will use a 10% Contingency factor, unless it involves "new" construction and currently use a 6.5% SIOH factor. The above percentages are entered on the "EDIT OWNER" entry screen located from the TITLE LEVEL where owner cost is set. Consult the PA-E for the applicable rate for your specific project.

18.0 REPORT OF COST AND BUILDING/STRUCTURE ANALYSIS

18.1 General. The "Report of Cost and Building/Structure" are used by CENAO-EN-C to prepare cost guidelines for future projects. These reports are to be furnished as a part of the Final A-E Cost Submittal. A revised report shall be submitted with the Corrected Final Submittal if any scope changes are made after the Final Submittal. Depending on project scope, the form will likely require some to revisions accommodate different building types, etc.

18.2 Buildings. (All applicable construction Category Codes). Reports shall be submitted for all new buildings funded by appropriated or nonappropriated funds. Reports shall be furnished for additions to existing buildings, but only when the estimated contract cost of the addition exceeds \$50,000.00. To the degree practical, reports for additions shall exclude the estimated cost of repairs and alterations in the existing building.

18.3 Liquid-Fuel Dispensing and/or Storage Facilities. (Construction Category Codes 12 and 410). Reports shall be submitted for all liquid-fuel dispensing and/or storage projects where the estimated contract cost exceeds \$50,000.00.

18.4 Paving. (Construction Category Codes 11 and 850). Reports shall be submitted for all projects where the quantity of paving of any one type specified exceeds 5,000 square yards. Separate reports are required for flexible pavement or rigid pavement where the quantity of either exceeds 5,000 square yards.

19.0 ADDENDUM TO BID SOLICITATION

During the bid period, any clarifications, redesigns, or other revisions to the plans and or specifications, which effect the final estimated construction cost by either an increase or decrease in price, shall be analyzed for cost impact and submitted to Cost Engineering for appropriate adjustment in the GE. These revisions to the estimate may be either MCACES generated, Excel or manually prepared estimates as appropriate.

20.0 ACTION WHEN ALL BIDS EXCEED GOVERNMENT ESTIMATE

After bid opening, if the bids received (to include apparent low bidder) are significantly higher than the Government's Estimate suggesting an unreasonable GE, there is a high probability that one or more bidders will protest the reasonableness of the Government Estimate. Another situation occurs when the designer/cost consultants' final estimate is not within 15% of the low responsive bid at bid opening. If either situation occurs, the designer has a contractual responsibility to assist the Government in a detailed review and evaluation of the Government's estimate. The designer/cost consultant will promptly conduct an independent view of the GE at no additional cost to the Government. This includes a detailed review to determine if the GE contains any omissions, discrepancies (errors in calculations, et.), quantity takeoff errors, or errors in cost and pricing data. In addition, the reviewer should further analyze any unusual conditions or circumstances that may affect or complicate the work. If the reasonableness of the GE is protested, the analysis will consist of in-depth, point-by-point response to all issues raised by the protester or contractor. The review analysis will consist of the GE, including all backup and supporting data, complete explanation about assumptions made and, if available, historical data from previous similar projects which support the estimate. The GE should be revised immediately if an error is found, and an explanation of the error should accompany the revised estimate. If the revised estimate brings an offeror's price within range of a fair and reasonable price, the Contracting Officer will review the situation and determine final contracting action.

21.0 ESTIMATES FOR CONSTRUCTION CONTRACT – MODIFICATIONS

21.1 General. In certain cases the A-E will be required to prepare estimates for construction contract modifications. These estimates are used as a basis of negotiations with Contractors for additions to or deletions from a project, or both, and shall be prepared in accordance with instructions of this chapter for Government Estimates.

21.2 Modification. The modification estimate shall be generated by MCACES.

21.3. Quantity Take-Off. A complete and detailed quantity take-off and accompanying cost estimate shall be submitted with the modification package. The quantity take-off and cost estimate shall be an accurate representation of the proposed modification as submitted and contain backup or supporting sheets showing breakdowns for all quantities of all materials being deleted from and/or added to the construction contract drawings and/of specifications. The quantity take-off shall be prepared in the same detail as required for the final cost estimate, including cross sections for earthwork quantities, equipment and material quotes, etc.

21.4 Modification Summary. Exhibit I shows an example of a typed modification summary format. This summary estimate shall be prepared for all modification packages. The typed summary format shall Show estimated contract cost of all work deleted from the construction contract by this modification as well as all work being added by this modification.

21.5 Construction Time. The estimated additional construction time, in calendar days, required as a result of this modification shall be shown on the typed summary sheet.

21.6 Principal Equipment. In addition to the quantity take-off the A-E shall submit quotes for the principal items of equipment as described in this chapter.

21.7 Overhead and Profit. The A-E shall prepare a detailed overhead and profit sheet as described in this chapter. The A-E shall prepare these sheets, to the degree practicable, to match the conditions of the Contractor constructing the project.

21.8 Government-Furnished Items. The following additional Government-furnished items will be supplied to the A-E whenever he is instructed to prepare a modification package.

21.8.1 Labor and Equipment Rate. The A-E shall contact the Area/Resident Engineer to obtain the actual labor rates being used by the Contractor as well as all of the Contractor's equipment on the project site and their applicable rental and/or ownership rates from EP 1110-1-8. This information shall be used by the A-E in preparation of the modification estimate. If the actual labor rates are not readily available, the A-E all use the Davis-Bacon wage rates included in the specifications for the project. The labor and equipment rates used by the A-E in preparation of the modification estimate will be submitted as part of the estimate backup data.

21.9 Audit Reports. Audit reports and results from previous modifications on this specific project to be used in adjusting labor productivity and material pricing will be furnished by the Project Architect/Engineer.

21.10 Checklist. The A-E shall submit a checklist, see Exhibit A, to be used as a cover sheet with each modification estimate submittal.

21.11 Government Estimate. The official Government Estimate will be prepared by CENAO-EN-C.

22.0 CATEGORY C

AR 415-28 identifies both Primary and Support Facility Category Codes. If the A-E contract scope of work requires that the Draft DD Form 1354 be prepared under the contract, then the Category Code Fields shall be completed and the Title quantities and UOM shall be consistent with AR 415-28. Otherwise, these fields need not be completed. Completing the Category Code Fields allows MCACES to interface with the software program which generates the DD Form 1354.

23.0 ORGANIZATION OF COST ESTIMATE SUBMITTALS & NO. COPIES

The submittal package shall consist of (depending on type submittal) and be submitted in the following order:

DOCUMENT(S)	NO. COPIES.
22.1 Title Page	2
22.2 Checklist for Cost Estimate Submittals	2
22.3 NAO Form 5 Control Sheet for Government Estimate	2
22.4 CWE Summary Calculations	2
22.5 Proposed Bid Schedule	2
22.6 Description of Base Bid, Alternates and Unit Price Items MCACES or other type estimate including:	2
22.7 Cover Sheet W/PROJECT NOTES -i.e., Executive Summary	2
22.8 Cost Estimate Table of Contents	2
22.9 Contractor Settings Report	2
22.10 Owner Settings Report	2
22.11 Main Summary Sheet	2
22.12 Primary Facilities Summary Sheets	2
22.13 Support Facilities Summary Sheets	2
22.14 Detailed Sheets	2
22.15 Quantity Take-Off Sheets (Separated by Facility & Discipline)	1
22.16 Principal Equipment & Material Quotes	2
22.17 Plan of Construction	1
22.18 Other Back-Up Information	2
22.19 Report, "Cost and Building Structural Analysis"	1
22.20 Electronic Copies (floppy diskettes) (Note one copy will generally be returned to the A-E with any NAO revisions)	2

---END OF CHAPTER---

CHAPTER 9

COST ENGINEERING EXHIBITS

EXHIBIT DESCRIPTION

- A CHECKLIST FOR COST ESTIMATE SUBMITTALS
- B NAO FORM 5, CONTROL RECORD FOR GOVERNMENT ESTIMATE
- C DETAIL PROCEDURES/INSTRUCTIONS FOR MCACES ESTIMATE
- D CHECKLIST/PROCEDURES FOR CREATING A NEW PROJECT
- E FORMAT AND EXAMPLE OF "CWE SUMMARY CALCULATIONS"
- F WEIGHTED GUIDELINES METHOD OF DETERMINING PROFIT
- G EXAMPLE AND FORMAT OF BID SCHEDULE
- H SAMPLE REPORT, "COST AND BUILDING STRUCTURAL ANALYSIS"
- I EXAMPLE AND FORMAT FOR PREPARING SUMMARY SHEETS FOR MODIFICATIONS
- J CHECKLIST FOR MERGING MULTIPLE PROJECT DATABASES
- K PRINTING THE UNIT PRICE DATABASE AND OTHER DATABASES
- L LIST OF NAO DATABASES

EXHIBIT A**CHECKLIST FOR COST ESTIMATE SUBMITTALS**

PROJECT: _____

LINE ITEM: _____

INSTALLATION: _____

FISCAL YEAR: _____

LOCATION: _____

TYPE OF ESTIMATE:

- ☐ Budget
- ☐ Pre-concept
- ☐ Concept
- ☐ Preliminary
- ☐ Final
- ☐ Corrected Final
- ☐ Other:

YES NO

- ☐ ☐ Title Page
- ☐ ☐ NAO Form 5 - Control Record for Government Estimate
- ☐ ☐ CWE Summary Calculations
- ☐ ☐ Proposed Bid Schedule
- ☐ ☐ Construction Cost Estimate Generated on "MCACES" following WBS format
- ☐ ☐ PROJECT NOTES contains Executive Summary Report
- ☐ ☐ Floppy diskettes containing the project database and saved to compressed
- ☐ ☐ Floppy diskette containing the NEW or REVISED databases (Models, Assemblies, Labor) if A-E added new data. Use save to compressed ref. paragraphs 9.17.8.2 and 3
- ☐ ☐ Quantity Take-off Sheets
- ☐ ☐ Plan of Construction
- ☐ ☐ List of principal items of equipment and price quotations
- ☐ ☐ Prime Field Overhead Itemized in the MCACES Project Estimate. Prime and subcontractors profit calculated by the weighted guidelines method in MCACES and notes added to each explaining factor used.
- ☐ ☐ Detailed description of the scope of work related to alternate bid and unit price items.

☐ ☐ Written narrative required when CWE exceeds Programmed Amount or Present Estimate is greater or less than 5% of Previous Estimate

☐ ☐ Report of Cost and Building/Structural Analysis

☐ ☐ Modification Typed Summary Format

☐ ☐ Equipment Rates (Modifications Only)

EXHIBIT B

CONTROL RECORD FOR GOVERNMENT ESTIMATE				
DATE RECEIVED	DATE OF DOCUMENT	NO. OF COPIES 1	COPY NO.	LOCAL CONTROL NO.
FROM:				
SUBJECT OR SHORT TITLE:				
NO. OR DESCRIPTION OF ENCLOSURES:				
INTRA OFFICE ROUTING DATA				
DIVISION OR BRANCH	TITLE	DIVISION/BRANCH/SECTION	DATE	
NAMES OF ALL PERSONS HANDLING THE ATTACHED DOCUMENT OR WHO HAVE BEEN INFORMED OF ITS CONTENT				
NAME	TITLE	DIVISION/BRANCH/SECTION	DATE	

NORFOLK DISTRICT - QUALITY FIRST

CENAO-TS-E

Computer Simulation 6 Nov 96
EXHAUSTED.

SUPPLIES OF WHICH MAY BE USED UNTIL

EXHIBIT C

DETAILED PROCEDURES/INSTRUCTIONS FOR MCACES ESTIMATES

NOTE: THESE INSTRUCTIONS ARE BASED ON MCACES GOLD VERSION 5.30. IF YOU ARE USING THE LATEST "WINDOWS" VERSION, TAILOR THESE INSTRUCTIONS TO THAT SOFTWARE PROGRAM ACCORDINGLY. THE BASIC PRINCIPALS REMAIN UNCHANGED.

1. Estimate Format

The format of all estimates shall follow the appropriate WBS (Military, HTRW, Civil) for the type estimate being created. The WBS should be studied in detail by all persons preparing the quantity take-off and the estimate. The WBS drives the way the quantity take-off will be prepared.

2. MCACES Software and Databases

All databases unique to Norfolk District will have an ID that begin with the first three characters "NAO" (North Atlantic Division Norfolk District). The Models, Assembly, Crew, Equipment, and Unit Price Book Databases all begin with NAO identification and shall be used on all projects unless otherwise directed. All labor, equipment, and material costs provided in these databases are a pricing guide only. It is the _A-E's responsibility to check, verify and adjust labor rates, crew production material pricing and mark-ups where applicable for specific project conditions. All databases are compressed to floppy diskettes and can be loaded from within the MCACES software using "Load From Compressed" on the SERVICE Menu. All floppies identified as databases shall be loaded into the \GOLD\DATA\ directories. All databases provided are FOR OFFICIAL USE ONLY and shall be protected accordingly.

NOTE: Load From Compressed - When using this command you are presented with a list of available databases to load for the Directory Path you indicated. To select a database use the Up/Down Arrow keys to highlight the database you want to load and press the [Space Bar]. This will place a check mark to the left of the database. This can be repeated for any or all databases. After marking the databases you want loaded press the [Enter] key to start the process.

2.1 Labor Rates Databases

Labor databases for locations under Norfolk District are provided on a Labor Rates floppy diskette. Select to load only the rates applicable to the project location. See paragraph 10 of this chapter for information about labor rates and any required change to rates. NOTE: Using the localized LABOR RATES database will result in the correct hourly labor cost not necessarily the correct unit cost for labor. The correct unit cost for labor will be achieved after adjusting crew composition and crew productivity where applicable for specific project conditions. As the items of work are brought into the project database they are re-priced with the currently selected LABOR, EQUIPMENT, and UPB (material only) databases. The labor and unit cost shown in the UPB, CREW, and ASSEMBLY databases will not show the same cost when brought into the project because these databases have not been re-priced to the localized LABOR RATES database.

3. Templates and Sample Projects

Norfolk District provides a Templates and Sample Projects floppy diskette containing compressed project templates and sample projects. This diskette contains Sample Projects to review the required format for the types of estimates prepared by the Corps of Engineers, (i.e. Civil, Military, and Hazardous, Toxic, and Radioactive Waste). It also contains specific project Templates for each type of estimate. The appropriate project template shall be used to initiate the project. All databases are compressed to floppy diskettes and can be loaded from within the MCACES software using "Load From Compressed" on the SERVICE Menu. All floppies identified as Projects (Templates/Samples) shall be loaded into the \GOLD\PROJECT\ directories.

3.1 Military Templates

For Military Estimates the "NAOMIL" Template shall be used to create the estimate format. Use "Load From, Compressed" on the SERVICE Menu to load the "NAOMIL NAO Military Project Template" into the \GOLD\PROJECT directory. After loading select "NAOMIL" in the database window and highlight with the cursor. Use "Copy a Database" from the SERVICES Menu to copy this project template into a unique six - character project ID. The NAOMIL template itself is not to be used for entering data. This template contains the proper format for creating the estimate, along with the WBS Titles, Project Information Records containing suggested Contractors and the beginning of an itemized Field Overhead for the prime Contractor "GC". It is suggested that this template be printed out before starting the estimate for use as a guide by all persons preparing the quantity take-off and cost estimate. This template includes most of the TRACES GENERIC WBS to the lowest title level. This printout, along with the Military WBS will help the Cost Engineer create the estimate in the required format.

3.1.1 Military Estimate Hierarchy

When creating a MCACES estimate it is important to recognize that the construction project consists of seven hierarchical levels, some coming from ENG Form 3086 and some from the Military WBS. They are defined as:

LEVEL 0 (Top Most Level)... "PROJECT INFORMATION RECORD" LEVEL
 LEVEL 1... PRIMARY/SUPPORT FACILITIES (ALSO VIEWED AT THE PROJECT INFORMATION LEVEL)
 LEVEL 2... INDIVIDUAL FACILITIES AND ASSOCIATED SUPPORT FACILITIES LEVEL 3... SYSTEMS
 LEVEL 4... SUBSYSTEMS
 LEVEL 5... ASSEMBLY CATEGORIES
 LEVEL 6... ASSEMBLY
 LEVEL 7... DETAIL

3.1.2 Project Level (LEVEL 0)

Level "0" is the Title "Project Information Record". All cost of the Primary Facilities and Support Facilities are accumulated to obtain a total project cost. This shall include all construction contract cost as well as Government-furnished materials and items furnished through funds other than construction funds, i.e., information systems.

3.1.3 Primary/Support Facilities (LEVEL 1)

Level 1 is accessed on the same screen as the Project Information Record; however, the Level 1 Titles are listed below "Project Information Record." Level 1 divides the project into Primary Facilities, Support Facilities, Category E Equipment, and Government-Furnished Equipment based on DD Form 1391 format for the project.

3.1.4 Individual Facilities (LEVEL 2)

Level 2 titles are included at the next "title level" below Levels 0 and 1, i.e., not the same screen. Individual Facilities/Buildings shall be listed under Primary Facilities and include all individual buildings identified by Category Codes in AR 415-28. If the project consists of more than one building in the same category code, each building shall be listed separately, even if the buildings are identical in size and scope. Support Facilities shall be listed separately for each primary facility. When Alternate bid items and items funded from different sources are required, they shall also be located at this level.

3.1.5 Systems (LEVEL 3)

Under Primary Facilities the Military WBS Systems 01 through 16 are titled at this level. If there are multiple Primary Facilities, each one shall be broken down by the 01 through 16 Systems. Under Support Facilities the Military WBS Systems 17 through 20 are broken down under the appropriate DD Form 1391/Eng Form 3086 titles.

3.1.6 Subsystem (LEVEL 4)

This level contains the Subsystem titles from the Military WBS for the above Systems. If there are subsystems in the project not identified by the Military WBS, they shall be identified using 90 through 99 under the appropriate System.

3.1.7 Assembly Category (LEVEL 5)

This level contains the Assembly Category titles from the Military WBS for the Subsystems above. If there are Assembly Categories in the project not identified by the Military WBS, they shall be identified using 90 through 99 under the appropriate subsystem.

3.1.8 Assemblies (LEVEL 6)

Assembly Titles shall be created at this level following the definitions contained in the Military WBS.

3.1.9 Detail (LEVEL 7)

Individual Cost Items are located at this lowest level in the estimate and reports at this level are referred to as the Detail Reports. These are the basic work tasks consisting of labor, equipment and material cost and is the same level of detail as that found in the Unit Price Book Database. Some of the basic work tasks can be modified by Modifiers from the UPB.

3.1.9.1 Modifiers

Modifiers are identified in the UPB database and provide a method of adding or reducing, for optional quality or scope to the work task costs. Each modifier acts solely on the basic cost item it is assigned.

3.2 Civil and HTRW Templates

For Civil and HTRW projects the "CIVTMP" Template shall be used to create the estimate format. Use "load From Compressed" on the SERVICES Menu to load the "CIVTMP Project Template" into the \GOLD\PROJECT directory. After loading select "CIVTMP" in the database window and highlight with the cursor. With the "CIVTMP" highlighted in the database window press [F2] ADD ITEM to create a project databases for your project. Enter a unique six-character project ID and project title. Pressing [F10] EXIT will save this information and create the project database. Make sure this new project database is selected and shows in the database window. The "CIVTMP" template itself is not to be used for entering data. This template contains the proper format for creating the estimate. The WBS Titles associated with your specific project shall be copied from the appropriate Civil Models Database or the HTRW Models Database.

3.3 Sample Projects

For military project example there is a project identified as "CHAPEL," which can be loaded from the SERVICES Menu using "Load From Compressed. "When Load From Compressed" is complete press "Y" to select. This project demonstrates the required estimate format breakdown that the A-E shall produce in their project.

4. Supplemental Databases

This diskette contains a Generic Models Database and an Assembly Database created by Norfolk District. Both the Assembly and Model's Databases contain the same information, which are a few generic type assemblies. Some of these assemblies may be applicable to your project and may be pulled into your estimate. Some of these assemblies may be close to your requirements and may be copied to a new Assembly ID and edited to create a new assembly to be used in your project. Both the Assembly and Models Database ID begin with the first three characters NAO. All databases are compressed to floppy diskettes and can be loaded from within the MCACES software using "Load From Compressed" on the SERVICE Menu into the \GOLD\DATA\ directories.

5. Required Services

The A-E shall supply the following Cost Engineering services.

5. 1 Overall Project Analysis

The overall project shall be analyzed by all disciplines involved in preparing the cost estimate to consider the following procedure before making the detailed quantity take-off. This shall be done before preparing the concept estimate as it will dictate the final estimate format needed in the preparation of the quantity take-off.

5.1.1 DD 1391

Review the drawings and DD Form 1391 for the project to determine the number of Primary Facilities required in the project. Should the DD Form 1391 contain vertical buildings that can be identified by AR 415-28 Category Codes (no matter how small), the A-E shall put these buildings under Primary Facilities in his estimate. When multiple buildings are involved make each building as a separate Facility under the Primary Facilities. (Example: Tactical Equipment Shop which has POL, Storage, and Sentry Buildings). When multiple buildings are being constructed at different sites the A-E shall prepare a separate facility for each building in the Primary Facility and separate Supporting Facilities for each building site. The A-E shall prepare a proposed Bid Schedule based on the Facility (Level 2) of the Primary Facility and the Support Facilities (Level 2) for Site Work.

5.1.2 Buildings

When the number of buildings have been defined in the Primary Facility, each of the buildings shall follow the WBS of defined Systems, Subsystems, Assembly Categories, and Assemblies. The Detail Quantity Take-off shall follow this same format.

5.1.3 Funding

When projects are funded by more than one funding source, all work related to each funding source shall be segregated respectively. Funding sources shall be identified separately at Level 2 in the MCACES estimate and shall be identified separately on the proposed Bidding Schedule. All work associated with each funding source shall be described on the plans and/or specifications in narrative to facilitate contractors bidding on the same scope of work for each bid item.

5.1.4 Army Projects

For Army projects, all information systems that are funded by OPA shall be a separate Bid Item in accordance with AR 415-15 provided in other documents. These systems shall be identified as specified in paragraph 5.1.3 above. This is not required for Air Force Projects.

5.1.5 Cost Estimate

See Exhibit D, Create New Project Checklist for detailed start-up procedures. If the cost estimate is to be prepared by more than one person on more than one computer and then merged into one Prime Estimate, follow the steps in Exhibit J, Checklist/Procedures for Merging Multiple Project Databases. Failing to follow these steps may result in cost data having to be re-entered to correct the corrupted database. It is very important to understand that the Merge and Extract only work correctly when the format of the databases are exactly the same.

5.2 Type of Estimate. The MCACES estimate should be set up as a Type "A - Crews with Auto Reprice." Note that if all parts of the estimate are not from the same source and are to be merged at completion, they must all be set up the same.

5.3 Sales Tax on Materials. Use the applicable state sales tax based on project location. For projects excluded from sales tax, i.e., certain environmental projects, exclude taxes where appropriate and provide a note accordingly in the project information notes screen.

5.4 Owner Markups. Set Owner markups to be applied at Level 01. This precludes owner markups from being applied to project costs that may not incur owner mark-ups such as Army communications costs, Government Furnished\Government Installed Equipment, etc.

5.4.1 Contingencies and SIOH. The A-E shall include contingencies and SIOH unless specifically excluded in contract instructions: See Exhibit E for a schedule of applicable contingency and SIOH rates based on project type. If there are any questions, contact the PA-E for clarification.

5.4.2 Escalation. The estimate shall include appropriate escalation factor. Contact Cost Engineering for appropriate Indexes.

6. Starting the MCACES Project

All program software and databases should be installed as described above. Activate the MCACES software following instructions from the CACES Software Manual. Before starting the project ensure that the appropriate Project Templates and Databases are selected in the DATABASE WINDOW. Reference Exhibit D, Create New Project Checklist.

6.1 Military WBS projects

6.1.1 For Military WBS Projects the NAOMIL Template shall be selected and copied as described above in paragraph 3.1. Select the new project using [F8] SELECT. The new Project ID shall now be in the DATABASE WINDOW.

6.1.2 With the new project highlighted press [F4] EDIT and enter the official description of the project title (abbreviate where necessary Press [F10] EXIT to save.

6.1.3 From the REPORTS Menu choose Edit Report Title Page. Enter the appropriate information as shown on the screen. Use Project Notes [F7] to describe the overall general scope of the project. See Exhibit D, Create A New Project Checklist for Project Notes instructions. Press [F10] to save.

6.2 Work on Project

Highlight the new project and press [Enter] to work on the project. The first item listed is the Project Information Record.

6.3 Prime Contractor

Choose to work on Project Information Records by highlighting the item and pressing [Enter]. The prime Contractor record is displayed. Edit the prime Contractor by pressing [F4] EDIT. The Field OH shall be set to "C" to calculate. Home Office shall be set to S (Separate Percent) and should be between 2 and 7 percent as described elsewhere in this chapter. Profit shall be "initially set to "C" and Bond shall be set to "C." Profit will be changed to "S" after calculating profit factor.

6.3.1 OTHER Screen

The last line on the screen (the Status Line) indicates that an Other Screen is attached to this screen by the prompt "OTHER." Choose the OTHER screen by pressing [Shift] [F7] or using the [F9] MENU ADD/EDIT. This brings forward the attached prime Contractor Window. The Profit Weighted Guideline method of determining profit shall be used for the prime Contractor and all major subcontractors (25% of total cost or more). Each Risk Factor field is HELP [F1] sensitive. By pressing [F1] HELP a description of the appropriate weight to apply to the project will be presented. Each Risk Factor shall be filled in based on the project cost, duration, complexity, and Contractor risks. After completing profit factor return to prime contractor screen and change the setting to "S" separate. The profit factor will remain unchanged; however, the "S" setting now allows you to return to the "other" screen and insert the prime's profit factor on subcontractor work. At this point enter prime contractor overhead and profit mark-ups for subcontracted work. See Sample Estimate, "CHAPEL," for example.

6.3.2 On the Other Screen, the Bond Class Field shall also be set to "B." This will cause the software to automatically calculate the Bond percentage used in the estimate. Press [F10] twice to save information on the prime Contractor. With the prime Contractor Record highlighted press [Enter] to work on the prime Contractor.

6.3.3 A list screen appears showing record 0 as the Itemized Field Overhead (or, as some refer to, "General Conditions") followed by a long list of typical subcontractors. Choose the Contractor's Field Overhead by pressing [Enter] to get a list of typical Field Overhead items for the prime Contractor. This list is provided only as a guide. The A-E shall add and delete items, edit quantities and adjust cost to represent a detailed itemized Field Overhead for this project. Pressing [F10] upon completion will save the data.

6.4 Subcontractors

Now highlight the subcontractors and [F4] EDIT them. The subcontractors' profit may be either fixed or calculated by the Profit Weighted Guideline for the "OTHER " window as was done for the prime Contractor. Any subcontractors not used in the estimate shall be deleted. In order for Contractors to be used in the estimate they must be assigned at the appropriate level within the Primary/Support Facilities. This will be discussed in detail later. [F10] EXIT until you are back at the Project Information Record.

6.5 Primary Facilities Title

Highlight the Primary Facility Title and [F4] EDIT. On the Primary Facility Edit Screen the quantity shall be LS (Lump Sum). Usually the prime Contractor ID "GC" is entered on this screen as he is usually the prime on all Facilities under Primary and support Facilities. The Contractor Override Field shall be set to "NO" and the Project Category Code (from DD Form 1391) is typed into the Category Code Field, unless there are more than one Primary Facility at level, in which case category codes should only be entered at Level 2 titles.

6.6 Facility Titles

Highlight the Primary Facility and press [Enter] to the default FACILITY "Building One" at level 2. Create the number of Primary Facilities that was determined from paragraph 5 above. To create another Facility highlight FACILITY "Building One" MARK this item by pressing [Shift] [F9] or using the [F9] FUNCTION, Menu - MARK. This places a check mark to the left of the title. Exit up a level [F10] and choose COPY from the FUNCTION

MENU - MARK or press [Shift] [F4]. This brings up a window allowing you to copy "AA.01. Building One" to a new location. Change the default AA.01 to AA.02 and press [Enter] to complete the copy. Now there are two identical Facilities under the Primary Facilities. Please note that if there are two or more identical or very similar facilities, it is recommended that you complete the detailed estimate for the first typical facility before you create or copy the next one. By doing this you will only need to make minor revisions (if any at all) to create the complete cost estimate for the similar facility. Continue this process for all Primary Facilities in the project. After creating all of the Facilities, [F4] EDIT each FACILITY TITLE and type in the name of the Facility, and Gross Square Feet of the Building as the Facility Quantity, UOM, and insert the Facility Category Code (from DD Form 1391 or AR 415-28) into the Category Code Field. Note that the category codes are required in order to interface with the software package which will generate the automated 00 Form 1354. Also see the quantity and UOM consistent with AR 415-28. If the prime Contractor was defined on the PRIMARY FACILITIES TITLE leave the Contractor Field blank. After editing the first facility pressing [PgDn] take you to the next facility to edit. Use the same basic procedure to define all the Support Facilities for each building at Level 2 under Level 1 Support Facilities title.

6.7 System Titles

With the FACILITY TITLE highlighted press [Enter] to go to Systems. The 01-15 System Titles and Selective Demolition System 16 are pre-define and the titles shall not be changed. Each title shall be edited to enter, the appropriate quantity as defined in the WBS. Any SYSTEM TITLE not used in the project shall be deleted. Sometimes subcontractors can be identified at the Systems Title level as all work performed in the system is normally accomplished by one Contractor. For example System 11 - Electric Power and Lighting is normally installed by the Electrical Contractor "EL." By identifying the "EL" contractor at this title level you need not identify this subcontractor at any level below this, as it is done automatically by the program.

6.8 Subsystem Titles

With the SYSTEM TITLE highlighted press [Enter] to go to Subsystems. The Subsystem Titles are pre - defined and the titles shall not be changed. Each title shall be edited to enter the appropriate quantity as defined in the WBS. When there are Subsystems in the project which are not defined in the WBS the A-E shall create them using 90 to 99 Identification code. Any SUBSYSTEM TITLE not used in the project shall be deleted. Subcontractors can also be identified at the Subsystem Title level if all work performed in the subsystem is normally accomplished by one Contractor.

6.9 Assembly Category Titles

With the SUBSYSTEM TITLE highlighted press [Enter] to go to Assembly Categories. The Assembly Category Titles are pre-defined and the titles shall not be changed. Each title shall be edited to enter the appropriate quantity as defined in the WBS. When there are Assembly Categories in the project which are not defined in the WBS the A-E shall create them using 90 to 99 Identification codes. Any ASSEMBLY CATEGORY TITLE not used in this project shall be deleted. Sometimes subcontractors can be identified at the Assembly Category Title level as all work performed in the category is normally accomplished by one Contractor. For example System 6 - Interior Finishes; Subsystem 01 -Wall Finishes; Assembly Category 03 - Gypsum Wallboard Finishes is normally installed by GW-Contractor and Assembly Category 04 - Tile and Terrazzo Wall Finishes is normally installed by the - Contractor.

6.9.1 When Assemblies can be used multiple times within the project it is beneficial to the cost engineer to create the Assembly in the MODEL's DATABASE rather than in the project. Assemblies from the MODEL's DATABASE can be copied into the project as often as required. The A-E shall copy the NAO Generic Models Database using Copy a Database on the SERVICES Menu to the same six characters as was used to name the project. Select this new Model's Database and use it to create new assemblies. This new Models Database shall be submitted along with the project database with each submittal. See paragraphs 8.9 and 16 of this chapter for submittal requirements.

6.10 Assembly Titles

The NAO project template contains typical Assembly Titles (without detail items) associated with military construction. The A-E shall revise the Assembly Titles by deleting inappropriate titles and adding titles based on the requirements of the project. The TRACES GENERIC WBS provides a description of detailed items found in the assemblies. If it is necessary to add Assembly Titles, use the following procedures. Note if using the latest MCACES for Windows version follow the instructions in User Manual.

6.10.1 To CREATE an ASSEMBLY TITLE.

Highlight the appropriate ASSEMBLY CATEGORY and from the FUNCTION MENU II ADD/EDIT" choose "Add Subtitle" or press [Shift] [F3]. This will put you in the Add Subtitle Mode where you must enter a two-character Assembly ID. This ID will normally be 01-99 but alpha characters may be used if required. You are now ready to look for an existing assembly or create a new assembly.

6.10.2 To SELECT, REVIEW AND REVISE an ASSEMBLY and DETAIL ITEM.

Press [F6] LOOKUP and choose either "Models" or "Assemblies" to look into the appropriate Database for available Assemblies that may exist. Be sure that the appropriate Model or Assembly database has been selected at the Main Menu. See paragraph 4. If an appropriate Assembly is located in the Database it can be copied into the project by highlighting the Assembly Title and pressing [F6] LOOKUP. You will be prompted to "Confirm LookUp" and by pressing [Enter] will accept what was looked up. You will then be prompted to "OMIT detail (Y/N)? N" with NO being the default. Press [Enter] to receive detail. With LookUp completed you will have the Assembly Title and Detail Items making up the assembly in your project. Press [F10] to exit and press [Enter] to select the Assembly and view the Detail List screen. If the detail items have the letter "P" to the Left of the Quantity in the Quantity field, the detail items have been linked to the "Parent Quantity," the Assembly Title in this case. If necessary detail items can be added or deleted based on project conditions. You will not be able to edit the quantity in Detail List if the item is linked; however, you can adjust the link value/relationship on the Link Quantity Screen, Control F7, from the Edit Detail Screen. You will also have to edit the Assembly Title screen to correct the assembly quantity in order to adjust the detail quantities. Finally, access the "other screen" Shift F7 at the assembly title level and adjust assembly productivity based on job conditions.

NOTE: Some of the Assemblies are not linked and the assembly quantity will not adjust the detail. This is the case when there is not a direct correlation between assembly quantity and detail quantity. When this is the case there will not be a "P" in the detail quantity field and the detail quantity has to be entered at detail. Each "non-P" Detail quantity will require editing.

6.10.3 CREATING a NEW ASSEMBLY. If there is not an assembly already created that reflects the assembly needed for the project, then the A-E shall create the assembly from detail items in the Unit Price Database. Locate the correct ASSEMBLY CATEGORY TITLE and Add Subtitle [Shift] [F3]. This puts you in the Assembly Add Screen where - you enter the Assembly ID, Title, Quantity and Assembly Unit of Measure. Reference TRACES GENERIC WBS for UOM's. Press [F10] to save. Choose to work on the newly created Assembly Title by pressing [Shift] [F5] ADD DETAIL. On the Cost Item Entry Screen the first two fields of the "Project Sequence/Database" ID requires no entry. Position the cursor to the third field and press [F6] LOOKUP and choose to look up into Unit Price [Shift] [F6]. The software will place you at the top of the Unit Price Database. After selecting or marking the detail items needed in the assembly press [F6] and then confirm lookup. This will return all detail items marked to your project. Press [F10] to exit Add Detail and save the items. Now check that all detail quantities are correct for your project by editing each item or, if appropriate, you can link the detail items to the assembly quantity. Paragraphs 6.1.9 through 6.1.11 shall be repeated for all Facilities under Primary Facilities.

NOTE: One must be located at DETAIL in the UPB when copying multiple detail items into the project, i.e. pressing [F6] to complete lookup. If [F6] is pressed while located at a title level, only the last marked item will be copied into the project.

6.11 Support Facilities Title

In most projects there is only one set of Support Facilities (only one Primary Facility is constructed on the site). When there is only one set of Support Facilities this title record needs only to be edited to identify the Prime Contractor.

6.12 Adding Additional Support Facilities

Occasionally there are projects that contain multiple Primary Facilities, or a project may consist of more than one site, and due to scope and or criteria changes or budget constraints, it is not uncommon that one or more buildings may be isolated as alternate bid items. For this reason it is necessary to takeoff and estimate support facilities for each primary facility separately. Therefore, when more than one primary facility occurs, Bldg. No. 1 Support Facilities Title shall be duplicated for each primary facility. To create another Support Facility highlight "Bldg No.1 Support Facility." MARK this item by pressing [Shift] [F9] or using the [F9] FUNCTION Menu - MARK. This places a check mark to the left of the title. Exit up a Level [F10] and choose COPY from the FUNCTION MENU - MARK or press [Shift] [F4]. This brings up a window allowing you to copy "AA.OX.? Bldg No. 1 Support Facility" to a new location. Change the default AA.01 to AA.O2 and press [Enter] to complete the copy. Now there are two identical Bldg No. 1 Support Facilities at level 2 under Level 1 Support Facilities. Continue this process for all Support Facilities in the project. Now edit each support facility title to mirror the primary facility title to the extent that the right support facility cost can be easily related to its primary facility.

6.13 Category Codes for Support Facilities. Refer to AR 415-28 to identify the category codes associated with support facilities, i.e., all applicable 800 and 900 Series numbers. Again, the category codes need to be identified in order for MCACES to properly interface with the software application which generates the DD Form 1354. Once all applicable codes for the project have been identified, enter the category code at the appropriate title or detail level which will result in capturing all related cost for that code. And make sure the quantity and UOM at this title level are consistent with AR 415-28.

7. Print Selected Reports

The following procedures shall be required by the A-E when creating the required printed reports for all submittals.

7.1 PACK A DATABASE

When submitting an estimate to Norfolk District the project database shall be packed to permanently erase deleted records from the project. From the SERVICES Menu choose Pack a Database while the project is highlighted in the Database Window.

7.2 SELECT REQUIRED REPORTS

The Norfolk District Required Reports settings shall be selected before executing the print command. From the REPORTS Menu choose Save/Load Report Settings. The first prompt asks if you want to Save Current Settings and the correct response is "N" for no. The second prompt asks if you want to Load Different Report Settings and the correct response is "Y" for yes. The Keyword Search Window now prompts for a Match ID. Type in the word SUBMITTAL and press [Enter] twice to activate the search. "SUBMITTAL Norfolk District Required Reports" will be one of the choices presented. Select this choice by highlighting with the cursor and pressing [Enter]. This will load the required reports settings. In the "Edit Report Title Page" screen, include in the "Prepared By" block the name AND telephone number of the cost engineer responsible for preparation.

7.3 Printer Setup The printer shall be set up to print in Landscape mode with 172 characters per line and 66 lines per page.

7.4 Activate Reports Generator

From the REPORTS Menu choose Print Selected Reports. Type in the estimate design status (Concept, Final, etc.) in the Report Title Field.

7.4.1 Send Reports to Printed

When sending the Reports directed to the printer as they are created enter PRN in the Printer Device Field and press [PgDn] to activate writing the reports.

7.4.2 Send Reports to File

If you want to send the Reports to file and print at a later time or view the reports before printing, type in a filename.txt in the Printer Device Field and press [PgDn]. This writes the reports to the file and the file can be printed later using the DOS Print command.

7.4.3 Viewing a Reports File

If the reports were written to a file, the file may be viewed using View Reports with Viewer from the REPORTS Menu.

8. Save to Compressed

After generating and printing the required submittal reports the databases shall be "Saved to Compressed" onto floppy diskette(s).

8.1 Compress Project Database

The project database shall always be Saved to Compressed. A formatted floppy diskette is required to complete this process. Highlight the Project in the Database Window. From the SERVICES Menu choose Save to Compressed and enter the Project ID. When prompted to "Save Related Databases along with Project?" respond "N" for No. When the compression process is complete save to the floppy.

8.2 Compress Assembly and/or Models Databases

If new items were created in the Models or Assembly Databases (reference paragraph 6.9), those databases shall be Saved to Compressed along with the project. To Save to Compressed the Assembly or Models Database highlight either and use Save to Compressed. When prompted with the path of the databases press [Enter] and a list of available databases will be presented. Use the up/down arrow to locate the database/s you want to compress and press the [Space Bar] to put a "Check Mark" by that database. When all databases have been marked press [Enter] to start the compression process. With the compression process complete save to floppy. The compressed Project is displayed with a check mark to the left of the ID in the "Keep Database Window." Press [Enter] to keep the project and also save the compressed Assembly or Models to the same floppy diskette. The next prompt will be "Diskette is NOT BLANK, Delete All Non-Database Files?" Respond "Y" for yes. This will save both the project and other databases to compressed floppy diskette.

8.3 Compress Labor Database

If new rates are created in the Labor Database the database shall be saved to compressed along with the project. Follow the same procedure as in paragraph 8.2.

8.4 Floppy Diskette Labels

The following information shall be recorded on all floppy diskettes submitted to Norfolk District.

Project Identification Code (6 character code) and the design status, i.e. "60% Estimate".
Project Title
Project No.
Location LOAD from Compressed 1 of ?

9. Printing Unit Price Database:

The Unit Price Database can also be printed for those who may want a hard copy. Reference Exhibit K, Printing The Unit Price Database And Other Databases, for printing instructions.

EXHIBIT D**CREATE A NEW PROJECT CHECKLIST**

[] The correct databases (Models, Assemblies, Unit Prices, Crews, Labor Rates, and Equipment Rates) are present in the Database Window.

[] The correct WBS Project Template has been selected.

[] The Project Template has been copied to new six character ID for this project.

[] The New Project has no been selected and name of project edited.

[] The Report Title Page has been edited for this project. Include Project No., title and location, design firm, estimator's name and telephone #, escalation index, effective pricing date, date prepared, estimated construction time and sales tax.

[] The Report Title Page Screen - Project Notes shall include an Executive Summary describing overall project scope to include brief description (area, size, type) of building arch, struct, mech & elect systems, and description of major site work elements. Executive Summary shall also describe basis of labor rates, material quotes and any "global" Pricing Adjustments for labor, equipment and material mar -ups, significant assumptions that could effect cost and pricing data, and any other information deemed pertinent to explain or justify certain elements of the cost estimate that the Government's reviewer should be aware. Executive Summary Notes contain important information that will also be available to others to use when accessing the Historical Analysis Generator to quickly determine if project scope and cost information will be of value for comparative analysis.

[] Prime and subcontractor I.D. fields and office overhead, profit and bond have been edited.

[] The correct number of Facilities have been created.

[] Items funded from different sources have been created.

[] Alternate bid items where applicable have been created and listed separately.

[] The required Assembly Titles for all Primary and Support Facilities have been created and detailed items entered into he Assemblies.

[] All System, Subsystem, and Assembly Category Titles not required in this project have been deleted and the Project has been packed.

[] All subcontractors not required in this project have been deleted and the Project has been packed.

EXHIBIT E

FORMAT AND EXAMLE OF TYPED CWE SUMMARY CALCULATIONS

Project Title. Project No. FY –
 Project Location
 Date
☐ Pre-Concept, ☐ Concept, ☐ Preliminary,
☐ Final Estimate,. Or ☐ Corrected Final Estimate –

SUMMARY
 (SUMMARY FOR FY - 88 AND BEYOND PROJECTS)

	BASE BID	ADDITIVE**	TOTAL
PROGRAMMED AMOUNT	\$5,000,000		\$5,000,000
LESS "OTHER" (Lump Sum VE, Comm, & EMCS) \$222,0001			\$222,000
SUBTOTAL	<u>\$4,778,000</u>	<u>\$4,778,000</u>	CONST COST LIMIT (CCL) BASE BID -
88.00% \$4,400,000	4,400,000		
(INCL CONT @5%, S&A @60%, AS-BUILT @0.5%, E&D @0.2%)			
=====			
CURRENT CONSTRUCTION COST W/O ESCALATION:			
CONTRACT COST -PRIMARY AC/BLDG ---	3,200,000		
3,200,000 CONTRACT COST -SUPPORT FACILITIES			434,9621
434,962			
ADDITIVES (List Below or Separately)--- 0	432,916	432,916	TOTAL
CURRENT CONTRACT COST (CCC) --	\$3,634,9621	\$432,916	\$4,067,878
(WITHOUT ESCALATION)			
CALCULATE ESCALATION:			
MIDPOINT MONTH () YEAR ()			
COST GROWTH FACTOR MIDPOINT INDEX	1580		
CURRENT INDEX	1520		
COST GROWTH FACTOR --3.95%			
ESCALATED CONTRACT COST (ECC)	3,778,543	450,005	4,228,548
CONTINGENCIES (5.00% ECC)	188,9271	22,500	211,427
(Used in example only, actual would be 5%-10%)			SUBTOTAL
(ECC W/Contingency)	3,967,4701	472,505	4,439,975
SIOH------(6.00% of CC W/Cont)	238,049	28,3501	266,399
	4,205,519		500,855
	4,706,374		
E & DURING CONSTR (0.5% of CC W/Cont)	19,8371	2,363	22,200
AS BUILT DRAWINGS (A-E) (0.2% of ECC W/Cont)--	7,935	7,935	

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NORFOLK DISTRICT - QUALITY FIRST**CENAO-TS-E**

* OTHER COST

* VALUE ENGINEERING 20,000 0 20,000 *

COMMUNICATIONS -----	127,000	0	127,000*EMCS
CONNECTION -----	75,000	0	75,000

CURRENT WORKING ESTIMATE (CWE)

ESCALATED	4,455,291	503,218
4,958,509		

** CWE/PA ----- 89.1% 10.00% 99.2%

ESTIMATED CONSTRUCTION TIME 485 DAYS

* OBTAIN FROM PROJECT ARCHITECT/ENGINEER AS APPLICABLE

** ADDITIVES REQUIRED WHEN CWE/PA EXCEEDS 95%

SIGNATURES

PREPARED BY:

SUBMITTED BY:

I.M. WRIGHT, P.E.
Cost EngineerU. BETTER BEE, P.E.
President, Best Guess, Inc.

NOTE: THIS FORMAT IS ALSO AVAILABLE ON AN EXCEL SPREADSHEET AND WILL BE PROVIDED TO A-E ON REQUEST. EXCEL SPREAD SHEET PROVIDES FOR MORE ADDITIVES.

EXHIBIT F**WEIGHTED GUIDELINES METHOD OF DETERMINING PROFIT**

PROCEDURES: Based on specific project circumstances and considering the explanation of weights below, select appropriate weight values from both experience and the tables on the following pages. For MCACES estimates, enter the weights via Contractors Overhead and Profit Entry Screens and the system will calculate profit. For manual estimates, multiply rates by weights. Add resulting values and round to the nearest tenth to obtain profit factor.

<u>FACTOR</u>	<u>RATE</u>	<u>WEIGHT(.03 -.12)</u>	<u>VALUE</u>
Degree of Risk	20 X	=	
Relative Difficulty of Work	15 X	=	
Size of Job	15 X	=	
Period of Performance	15 X	=	
Contractor's Investment 5 X		=	
Assistance by Government 5 X		=	
Subcontracting 0 X		=	
TOTAL _____			

EXPLANATION OF WEIGHTS: REMEMBER - FOCUS ON THE FEATURE OF THE WORK BEING PERFORMED BY THE CONTRACTOR/SUBCONTRACTOR FOR WHICH YOU ARE EVALUATING PROFIT. FOR EXAMPLE, DO NOT ANALYZE PROFIT FOR TILE SETTER IN TERMS OF THE TOTAL PROJECT SOME WORK WILL INHERENTLY BE MORE DIFFICULT AND INVOLVE HIGHER RISKS.

1. **DEGREE OF RISK.** A subjective evaluation. Weight within a range of .03 for slight risk to .12 for highest risk. Consider lump sum items riskier than unit price items. Consider time of year for construction where appropriate. Also consider nature and location of work, amount subcontracted, ratio of labor to total cost and whether work has already been accomplished (modification after the fact).
2. **RELATIVE DIFFICULTY.** A subjective evaluation. Weight within range of .12 for most difficult and complex to .03 for simplest work. This factor is also tied to some extent to the degree of risk. Consider the nature of the work, by whom it is to be done, logistics, weather, location, time schedule, etc.
3. **SIZE OF JOB.** An objective rating. See appropriate table on following pages.
4. **PERIOD OF PERFORMANCE.** An objective rating. See appropriate table on following pages.
5. **CONTRACTORS INVESTMENT.** A subjective evaluation. Weight within range of .03 to .12 for below average to above average. Consider amount subcontracted, frequency of progress payments, whether there is pay item for mobilization, etc.
6. **ASSISTANCE BY GOVERNMENT.** A subjective evaluation. Weight within range of .12 to .03 for average to above average. Consider use of Government facilities, expediting assistance, etc.

7 SUBCONTRACTING. An objective rating. See appropriate table on following pages.

**WEIGHTED GUIDE LINE
PROFIT DETERMINATION SIZE OF JOB**

SIZE OF JOB	FACTOR	SIZE OF JOB	FACTOR
0 100,000	0.120	3,300,000 3,400,000	0.073
100,000 200,000	0.119	400,000 500,000	0.071
200,000 300,000	0.117	500,000 600,000	0.070
300,000 400,000	0.116	600,000 700,000	0.069
400,000 500,000	0.114	700,000 800,000	0.067
500,000 600,000	0.113	800,000 900,000	0.066
600,000 700,000	0.111	900,000 4,000,000	0.064
700,000 800,000	0.110	4,000,000 100,000	0.063
800,000 900,000	0.109	100,000 200,000	0.061
900,000 1,000,000	0.107	200,000 300,000	0.060
1,000,000 100,000	0.106	300,000 400,000	0.059
100,000 200,000	0.104	400,000 500,000	0.057
200,000 300,000	0.103	500,000 600,000	0.056
300,000 400,000	0.101	600,000 700,000	0.054
400,000 500,000	0.100	700,000 800,000	0.053
500,000 600,000	0.099	800,000 900,000	0.051
600,000 700,000	0.097	900,000 5,000,000	0.050
700,000 800,000	0.096	5,000,000 10,000,000	0.040
800,000 900,000	0.094	OVER 10,000,000	0.030
900,000 2,000,000	0.093		
2,000,000 100,000	0.091		
100,000 200,000	0.090		
200,000 300,000	0.089		
300,000 400,000	0.087		
400,000 500,000	0.086		
500,000 600,000	0.084		
600,000 700,000	0.083		
700,000 800,000	0.081		
800,000 900,000	0.080		
900,000 3,000,000	0.079		
3,000,000 100,000	0.077		
100,000 200,000	0.076		
200,000 300,000	0.074		

**WEIGHTED GUIDE LINE
PROFIT DETERMINATION
PERIOD OF PERFORMANCE**

PERIOD OF PERFORMANCE	FACTOR
OVER 24 MONTHS	0.120
23 TO 24 MONTHS	0.116
22 TO 23 MONTHS	0.112
21 TO 22 MONTHS	0.109
20 TO 21 MONTHS	0.105
19 TO 20 MONTHS	0.101
18 TO 19 MONTHS	0.098
17 TO 18 MONTHS	0.094
16 TO 17 MONTHS	0.090
15 TO 16 MONTHS	0.086
14 TO 15 MONTHS	0.082
13 TO 14 MONTHS	0.079
12 TO 13 MONTHS	0.075
11 TO 12 MONTHS	0.071
10 TO 11 MONTHS	0.068
9 TO 10 MONTHS	0.064
8 TO 9 MONTHS	0.060
7 TO 8 MONTHS	0.056
6 TO 7 MONTHS	0.052
5 TO 6 MONTHS	0.049
4 TO 5 MONTHS	0.045
3 TO 4 MONTHS	0.041
2 TO 3 MONTHS	0.038
1 TO 2 MONTHS	0.034
UNDER 30 DAYS	0.032
0 DAYS	0.000

NOTE: Weight "0" for if change order work not requiring time extension.

EXHIBIT G

BID SCHEDULE EXAMPLE

EXPAND MAINTENANCE FACILITY

LINE ITEM: FY -

FORT RAMBO VIRGINIA

Solicitation Number DACA65- -8-0000

ITEM Description	Estimated Quantity	Unit Unit	Price	Total
1. Modify Four (4) Existing Vehicle Maintenance Shops, Complete to 5-foot Line,	Job	L.S.	xxxx	_____
2. Construction of New Vehicle Maintenance Shop, Excluding Two Bridge Cranes (Bid Item No.3), Complete to 5-foot Line,	Job	L.S.	xxxx	_____
3. Two Bridge Cranes, Complete	Job	L.S.	xxxx	_____
4. Construction of Deployment Storage Building, Complete to 5-foot Line,	Job	L.S.	xxxx	_____
5. Construction of Out Buildings (Oil Storage House and Pump House), Complete to 5-foot Line,	Job	L.S.	xxxx	_____
6. 190 mm (7-1/2 Inch) Concrete Hardstand, Complete	9699	m ²	xxxx	_____
7. Roller Compacted Concrete (Including Approved Test Section)	19,757	m ²	xxxx	_____
8. Roller Compacted Concrete – Cement	980	445 N (100-Lb.) CY	xxxx	_____
9. Roller Compacted Concrete - Pozzolan	490	445 N (100-Lb.) CY	xxxx	_____
10. Site Preparation and Development, Including Utilities and Oil Tanks, Complete	Job	L.S.	xxxx	_____

NORFOLK DISTRICT - QUALITY FIRST

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TOTAL BASE BID - ITEMS 1 THROUGH 10

ADDITIVE NO. 1

11. Construction of Fuel Island Canopy, Complete	Job	L.S.	xxxx	_____
-----------------------------------------------------	-----	------	------	-------

TOTAL BASE BID PLUS ADDITIVE NO. 1 _____

ADDITIVE NO. 2

12. Additional Bay to New Shop Building, Complete	Job	L.S.	xxxx	_____
------------------------------------------------------	-----	------	------	-------

TOTAL BASE BID PLUS ADDITIVE NOS. 1 and 2 _____

EXHIBIT H

SAMPLE REPORT, COST AND BUILDING/STRUCTURE ANALYSIS

Project No. & Title: _____
 Title of Individual Facility: _____
 Installation Name: _____ Location: _____
 Line Item: _____ FY: _____
 Design Based On(Drawing No.) _____ Category Code: _____
 Definitive: _____ Solicitation No.: _____
 Standard: _____ Drawing No.: _____
 Other: _____ Contract No.: C.O.E.

Design A-E Firm: _____

Estimating Consultant: _____

Bid Opening Date: C.O.E. Award Date: C.O.E.

Number of Bidders: C.O.E. MCACES Estimate (Y/N): _____

MCACES File Name: _____ Type Of Funds: _____

Construction Period: _____

Low Bidder: C.O.E.

 Analysis of Project and Building Cost
 -----Complete

Project Cost Individual Bldg/Structure Cost

Budget Amount \$ C.O.E. \$ C.O.E.

Government Estimate

\$ C.O.E. \$ C.O.E.
Low Bidder Amount \$ C.O.E. \$ C.O.E.

2nd Low

Bidder Amount \$ C.O.E. \$ C.O.E.

3rd Low Bidder Amount \$ C.O.E.

\$ C.O.E.

Building/Structures Parameters

Gross Areas

No. of Stories	Per Bldg (Sq. Ft.)	No. of Bldgs. (Sq. Ft.) Directive	Total (w.o Basement) Basement Area //Budget	(Sg._Ft.)

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Number of Identical		Final		Buildings:	

Foundation		Description of Construction		-----Foundation Walls	
Spread	Steel	Structural Frame	Concrete	Unit	Piles
Concrete		Reinforced	Masonry	Footings	
		Other:	Other:	Wood	None ---
Exterior Walls _____					
Other: _____					

Concrete Slab	Concrete Slab	Other: Wood	Concrete	None	-----
_____	Concrete	Concrete On	Wood	None	-----
Fill-Elev. _____					
_____ Bar Joist _____					
_____ Roof Deck _____					
Other:	Concrete	Concrete	Poured	Precast	Metal Deck
Asphalt Shingle	Standing Seam	Other:	-----		
	Metal Roof	Provides Facilities For The Handicapped			
Yes	No	-----			

Air Conditioning System		Conditioned Space-----		Air Conditioned	
Tonnage (Tons):		Type:	Area (SQ. Ft):		
		Type:	Heated Area	Heating Fuel System	(SQ. Ft)
		Type:	Type:		
_____ Fire Protection 11 11 _____					
----- Protected					
System		Area (SQ. Ft)		Type:	
_____ Use Space If There is More Than One Type of Fire Protect Sys					

EXHIBIT I

SAMPLE SUMMARY SHEET CONSTRUCTION MODIFICATIONS

DATE: _____

GOVERNMENT ESTIMATE OF REASONABLE CONTRACT COST
FOR
MODIFICATION TO CONTRACT NO. DACA 21-8-C-0000
PROJECT TITLE _____
INSTALLATION NAME _____ LOCATION _____

ITEM NO.	DESCRIPTION	AMOUNT
	Delete 10" Precast concrete aircraft parking apron	\$100,000.00
	Add 15" Precast concrete aircraft parking apron	\$150,000.00
	Total additional contract cost to the Government for this Modification	\$50,000.00
	Total estimated additional construction time required to incorporate this modification into existing construction contract -10 calendar days	

Prepared By: _____

Approval Recommended By: _____

Approved By: _____

Cost Engineer Name and
AE Firm NameChief, Cost Engineering Chief,
Section

EXHIBIT J**CHECKLIST/PROCEDURES FOR MERGING MULTIPLE PROJECT DATABASES**

- [] Project Database must have the identical layout to Merge Correctly.
- [] The Prime Cost Engineer created the agreed upon total project layout as determined in paragraphs 17.5.1 through 17.5.1.5 conforming to the instructions in paragraphs 17.6 through 17.6.7 and 17.6.11 through 17.6.12.
- [] Copy this newly created project layout to Project Databases for each of the Cost Engineering disciplines that will be preparing their cost data separately. Each of these Project Databases are exactly the same at this point.
- [] Each Cost Engineering discipline (including the Prime) shall edit their individual Project Database and DELETE and PACK all System Titles that are not applicable to their discipline.
- [] Each Cost Engineering discipline (including the Prime) shall complete the quantity take-off following the same format that is in their Project Database in accordance with paragraphs 17.6.7 through 17.6.12.
- [] After each discipline has completed their project and BEFORE merging, each project should be printed. Choose "Print Selected Reports" from the REPORTS Menu and print the individual project to be sure no database is corrupted and all errors have been corrected. You can send these reports to a file instead of the printer.
- [] Pack the Project Database one final time before Merging.
- [] The Prime Cost Engineer will collect the individual projects for merging into the Prime Project. Make sure there is adequate hard disk space for EXTRACTING and MERGING project.
- [] MAKE DUPLICATE COPIES of all Project Databases before beginning the EXTRACTING/MERGING process.
- [] Carefully read the Merge and Extract functions in Chapter 18.7 and 18.8 of the MCACES Software Manual, Vol. I.
- [] Practice Extracting and Merging on small project databases to insure you understand the complete process.
- [] Select the Project Database to be Extracted and press [Enter] to open up the project.
- [] Using [Shift] [F9] or Mark from the MARK Menu to mark Titles to be Extracted. Titles should be marked at the highest level applicable for the information to be Extracted.
- [] From the MARKS Menu select "Extract To..." or press [Alt] [X] to begin the Extract function. This will create an identical database of the marked items in a unique filename. Write down the filename for later use.
- [] Now select the Project Database where the extracted data is to be merged. Press [Enter] to open the database and choose "Merge From..." on the MARK Menu or press [Alt] [E]. You will now be prompt to enter the path and filename you Extracted To above.
- [] Examine the project to confirm that everything was merged properly.

EXHIBIT K**PRINTING THE UNIT PRICE BOOK DATABASE AND OTHER DATABASES**

It is recommended that when printing the Unit Price Book Database (UPB) that you print only one CSI Division at a time and that you print only on a laser printer. The approximate number of pages for each Division with Full Description are:

DIV	PAGES	DIV	PAGES
01	72	09	42
02	285	10	28
03	58	11	39
04	36	12	2
05	46	13	112
06	25	14	16
07	30	15	305
08	50	16	306

CHECKLIST

Locate the cursor on the Unit Prices of the DATABASE WINDOW.

Choose "Select Reports to Print" from the REPORTS Menu.

[] In the "HEADING" field of the Select Reports Screen type in the description you want to see printed at the top of each page in the report.

[] In the "LIST Unit Price" field choose "YES -List All" using [F8] SELECT, or by pressing the [Space Bar] until it appears in the field and press [Enter] to confirm.

[] Set the range you want to print in the "FROM and TO" fields. For example to print CSI Division 01 only, type in "01" and press [Enter] in the "FROM" field and "0199999999" and press [Enter] in the "TO" field. This will print starting at the very beginning of Division 01 and stop with the last CSI numbered item.

[] Set the LIST Crews, Labor Rates, and Equip Rates fields to "NO Exclude All" following the method in LIST Unit Price above.

[] Under LISTING OPTIONS set the Source(s) field to "Exclude"

[] Let the "Pricing Date" field default to the current date.

[] Set UPB Material Indicators field to "No",

[] Set UPB Table of Contents field to "Yes",

[] Set the Formatting field to "Full Description" and [Page Down] to confirm entire Screen.

[] You should now be located at the Print Selected Reports screen. The Report Title field defaults back to the description entered in the HEADING field.

[] The Print Device field should be set to operate with your system. Printer Setup field should be set for Landscape. See paragraph 17.7.3, Chapter 10 of this manual.

[] Other databases may be printed by first placing the cursor on the database in the Database Window and choosing the REPORTS Menu. Fill in the other fields as appropriate.

EXHIBIT L**NAO DATABASES**

GENERAL: In addition to the databases contained in the MCACES system, Cost Engineering at NAO uses the following database ID#s. In most cases the NAO database is a copy of the MCACES database with some modifications. Should the A-E revise either an NAO or MCACES database, follow instructions for copying databases but revise the ID# as follows:

DATABASES

UNIT PRICE BOOK	NAOUPB to NAUXXX Use last three digits of Project # @ X's
CREWS	NAOCRW to NAC XXX Use last three digits of Project # @ X's
LABOR*	NAOLAB to NALXXX Use last three digits of Project # @ X's
EQUIPMENT	NAOEQP to NAEXXX Use last three digits of Project # @ X's

* Only if MCACES database, if NAO provided database, follow instructions below. Revise database title to include project title.

LABOR DATABASES

Labor databases will be updated by NAO before distribution to the most current Davis Bacon published rates and database titles will include the date of the Davis Bacon Wage Decision. The A-E is still responsible for adjusting rates for the current labor market and or job site conditions where appropriate.

Generally, the wage rates used for "outside" or "site work" labor classifications such as "Outside Plumber" found in the Labor Databases supplied by NAO for Residential and Building databases are the same rates used for the "building" labor rates found in the labor database, i.e., "Plumber". This is the rule since the site work for most of our projects is generally considered "incidental" relative to the total project scope. For large building projects however, which include other than incidental site work, the specifications may include more than one wage determination, i.e., for a major new family housing development involving a virgin site requiring significant road and utility construction, the project could require as many as three II wage determinations, i.e., Residential, Highway and Water & Sewer. Three wage decisions on the same project would be unusual; however, two would not. It is recommended that the cost engineer in these situations first contact Cost Engineering Section for guidance.

When more than one wage decision is anticipated, use the appropriate Residential or Building database as the source database for the estimate but edit the "Outside" or "site work" related labor classification wage rates to confirm with the applicable scales in the Highway, and Water & Sewer databases, using the highest rate where overlapping classifications occur. Suggest you print out applicable databases then use the highest rate in the source Residential/Building database for the "outside" classifications.

NAO LABOR DATABASES

NAO-VA	Virginia Statewide Average (used for statewide IDC contracts)
NAO-DR	Virginia Statewide Dredging Contracts
NAO-SR	Virginia Statewide Service Contracts
NAOFEB	Fort Eustis Building Construction
NAOFEC	Fort Eustis Civil/Heavy Construction
NAOFEH	Fort Eustis Highway
NAOFEU	Fort Eustis Water & Sewer

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NAOFER	Fort Eustis Residential
NAOFMB	Fort Monroe Building Construction
NAOFMC	Fort Monroe Civil/Heavy Construction
NAOFMH	Fort Monroe Highway
NAOFMU	Fort Monroe Water & Sewer
NAOFMR	Fort Monroe Residential
NAOFSB	Fort Story Building Construction
NAOFSC	Fort Story Civil/Heavy Construction
NAOFSH	Fort Story Highway
NAOFSU	Fort Story Water & Sewer
NAOFSR	Fort Story Residential
NAOLAB	Langley AFB Building Construction
NAOLAC	Langley AFB Civil/Heavy Construction
NAOLAH	Langley AFB Highway
NAOLAU	Langley AFB Water & Sewer
NAOLAR	Langley AFB Residential
NAOFLB	Fort Lee Building Construction
NAOFLC	Fort Lee Civil/Heavy Construction
NAOFLH	Fort Lee Highway
NAOFLU	Fort Lee Water & Sewer
NAOFLR	Fort Lee Residential
NAOFPB	Fort Pickett Building Construction
NAOFPC	Fort Pickett Civil/Heavy Construction
NAOFPH	Fort Pickett Highway
NAOFPU	Fort Pickett Water & Sewer
NAOFPR	Fort Pickett Residential
NAODSB	Defense Supply Center Richmond (DSCR) Building Construction
NAODSC	Defense Supply Center Richmond (DSCR) Civil/Heavy
NAODSH	Defense Supply Center Richmond (DSCR) Highway
NAODSU	Defense Supply Center Richmond (DSCR) Water & Sewer
NAODSR	Defense Supply Center Richmond (DSCR) Residential
NAOMB	Radford Army Ammunition Plant (MAP) Building Construction
NAOMC	Radford Army Ammunition Plant (MAP) Civil/Heavy
NAOMH	Radford Army Ammunition Plant (MAP) Highway
NAORAU	Radford Army Ammunition Plant (MAP) Water & Sewer
NAOMR	Radford Army Ammunition Plant (MAP) Residential

CREWS DATABASES

NAOCRW	Crews Database
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EQUIPMENT DATABASES

NAOEQP	Equipment
--------	-----------

UNIT PRICE BOOK

NAOUPU	Unit Price Book, U.S. Measurements
NAOUPM	Unit Price Book, METRIC Measurement

ASSEMBLIES

NAOABC	Typical Assemblies Building Construction
NAOACW	Typical Assemblies Civil Works Construction

NAOAHT Typical Assemblies HTW Construction

CHAPTER 10

SURVEYING AND MAPPING REQUIREMENTS

1.0 SURVEYING AND MAPPING.

1.1 General. When surveying and mapping are performed by the commercial A-E it must be accomplished by and stamped by qualified personnel licensed in such work. The survey is intended to furnish general information and data for design purposes and every effort should be made to have it thorough and not of a preliminary nature.

1.2 Procedures. In addition to any specific survey requirements prescribed in Appendix A of the design contract for the project, the following also apply:

a. Topographical surveys shall be by plane table, transit-stadia, right angle topography, total-station radial survey, or Differential Global Positioning System which will produce a map conforming to National Standards of Map accuracy as established by the Defense Mapping Agency and the U.S. Geological Survey unless otherwise permitted. Horizontal control for surveys is based on localized base unless otherwise directed and of third order accuracy. Base lines is established throughout the survey area with a minimum of one base line with two semi-permanent markers (recoverable) shown on each final sheet. Show the location and distance between markers and markers referenced to identifiable features. Base vertical control for surveys on either USGS or USC & GS Mean Sea Level (MSL), National Geodetic Vertical Datum (NGVD) of 1929 or 1988 unless otherwise directed and to a third order accuracy. Identify datum with a note on topographic sheet. Establish benchmarks for vertical control so that the distance between them does not exceed 300 m (1000 ft). These benchmarks are to be established in areas that are expected to be free from disruption due to construction activity. Give elevation measurements in meters. Convert benchmark elevations from ft to meters. Show horizontal alignment data (curve information, equations, etc.) and benchmark elevations to the closest 0.005 m. (Example: 314.15 ft = 95.753 m) Show roadway elevations, used for pavement tie-ins, vertical clearance computations, and spot elevations to the closest 0.01 m. (Example: 314.15 ft = 95.75 m) Show all other offsets, pipe diameters, ground spot elevations, physical feature dimensions, etc. to the closest 0.10 m. (Example: 314.2 ft = 95.8 m) Contour intervals should be 1 m, 0.5 m, or 0.25 m depending on site slope. Plot surveys on dimensionally stable material or in digital form, if directed. Draw line weights and symbolization compatible with map scale and consistent with accepted drafting practices. Use scale of the survey and contour interval as specified in the following paragraphs, unless otherwise directed.

(1) Surveys of road complexes and ranges, especially range complexes, may be plotted at a scale of 1:500 (1"= 50') or even 1:1000 (1"= 100') to reduce the total number of sheets required in the final contract drawings. However, show the topography around the assembly and parking areas, building sites target locations, etc., at the preferred scale of 1:300 or 1:200 (1" = 30' or 20') to assure clarity of the final Grading Plan (This may be done photogrammetrically when preparing the individual Site Plan drawings.) Mapping may be requested in metric or English units.

b. Conduct basic mapping control, "P" lines for route surveys, as-built control, and cadastral surveys to 3rd Order accuracy, both horizontally and vertically, and comply with the standards and Specifications for Geodetic Control Networks (Sept 84). NOAA Federal Geodetic Control Committee.

- c. When surveys include legal land surveys or descriptions, accomplish the work accomplished IAW Bureau of Land Management methods and procedures, state statutes where appropriate, and by or under supervision of a professional land surveyor holding a current license issued by the state in which the work is located.
- d. All extension of survey control and mapping accomplished by photogrammetric methods and procedures shall comply with the National Map Standards of Accuracy.
- e. Inform the government of proposed methods, procedures, and type of equipment to be used, if the work will be subject to inspection and review by Government personnel. However, the A-E retains responsibility for the quality of the work within the limits prescribed in the design contract.
- f. When any endangered species are believed/known to inhabit the proposed project site, coordinate this information the Using Activity (DPW/BCE). Plot the location of nesting or den trees and clearly identify on the topographic map, as these locations will definitely affect the final location of the proposed project.
- g. Obstruction surveys include a topographic survey within the prescribed limits of the easement, determining the evaluation of obstructions, and establishing property lines and ownership. These surveys may include placing tags on trees which are obstruction with pertinent information for clearing which shall be recorded in standard field books. These surveys are generally performed at a scale of 1:1000 or 1:300 (1"=100 or 1"= 30').

2.0 TYPICAL DATA.

a. Topographical Survey. (Scale of 1:300 (1" = 30') preferred or as indicated. 1:200 (1" = 20') may be used for small sites, unless otherwise directed).

- (1) Survey of area (show property lines and ownership, and location(s), elevation(s) and descriptions of BM's/TBM's).
- (2) Limits beyond area, as required (see special instructions).
- (3) Finished floor elevations of building(s) on or adjoining project site.
- (4) Heights, construction/functional use, type, and characteristics of existing structures, including building numbers.
- (5) Roads, streets, and trails; sidewalks; and paved areas.
 - (a) Typical roadway section(s).
 - (b) Profile roadway (C/L).
 - (c) Limits of right-of-way (R/W).
 - (d) Type of construction (gravel, asphalt, etc.).
 - (e) Condition of surface (cracked, pothole, etc.).
 - (f) Street names: township, county, state and federal highway numbers.
 - (g) Culverts: size, type, material type, invert elevations, and condition.

- (h) Bridges: size, type, material, and condition.
- (i) Guardrail: location, and type of material.
- (j) Distance from storm drain inlets to trunk line.
- (k) Sidewalks, w/spot elevations.
- (l) Trails.
- (m) Curbs: type, spot elevations along gutter line and top of curb.
- (n) Joint layout of airfield and hardstand pavements with spot elevations at join

(6) Railroad

- (a) Alignment of track and location of road crossings.
- (b) Number of tracks & weight of steel rail.
- (c) Elevations along base of rail.
- (d) Locations of turnouts and sidings (Station point of switch and turnout no.).
- (e) Drainage structures: size, type, material type, invert elevation and condition.
- (f) Width of right-of-way (R/W).
- (g) Name of serving company (NPBL, NS, RF&P, CSX Systems, etc.).
- (h) Distance to nearest station(s) or milepost.

(7) Utilities:

(a) Water:

- 1. Alignment of pipeline(s) within the project area.
- 2. Type (material, i.e., C.I., STL, PVC, D.I., etc.) and size of pipe.
- 3. Depth below existing ground line.
- 4. Storage capacity of tank(s).
- 5. Location of fire hydrants.
- 6. Valve locations.
- 7. Vent locations for cased pipe.

(b) Sanitary Sewer Collection:

- 1. Alignment of pipeline(s) within the project area.
- 2. Material type and size of pipe (RCP, DIP, etc.).
- 3. Depth below existing ground line.
- 4. Manholes: size and top & invert elevations.
- 5. Vent locations for cased pipe.

(c) Sewage Disposal Facilities:

- 1. Location and size.
- 2. Elevations at top and bottom of Structure(s).
- 3. Elevations of inlet and outlet pipes.

(d) Storm Drainage:

- 1. Alignment of pipelines within the project area.
- 2. Type and size of pipe (CMP, RCP, etc.).
- 3. Depth below existing ground line.
- 4. Manholes: Size and top & invert elevations.
- 5. Profile of open ditches above and below culverts and surface inlets.

6. Inlets: top and invert elevations, and number and size for grates. For curb type inlets with no grate, give length of opening, invert elevation at throat (gutter line), and top elevation of structure directly over the opening.
7. Dimensions of inlet Structure(s).
8. Delineate extent of drainage areas (For drainage area map in design analysis).
9. Headwalls: give type, dimensions, pipe diameter(s) and invert elevations(s) at end(s) of pipe.
10. Where pipe terminates in ditch without a headwall, indicate if flared end section (FES) or end of pipe is in good condition or damaged. Also, if ditch is stabilized or eroded.
11. Where storm drainage pipe extends beyond survey limits, secure length and invert elevation of pipe at next structure upstream or downstream to determine percent slope of pipe.

(e) Natural Gas and Fuel Dispensing & Storage:

1. Type, source and capacity of tanks, if available.
2. Alignment of fuel lines, depth, type, pipe size and pressure.
3. Name serving company.
4. Location of vents for cased utility lines.

(f) Electrical Power:

1. Alignment of powerlines (aerial or underground within the project area.
2. Pole locations and heights.
3. Number of wires, size and material; height above existing ground line at pole.

(g) Utilities (Miscellaneous):

1. Type, alignment, size, function, material as for steam, hot water, sewer, storm drains, chilled water, hydraulic, fuel and electrical shown above.

(8) Ground Covers:

(a) Type of crop, where applicable.

(b) Grass.

(c) Brush.

(d) Trees: Species, diameter, height, condition, location of all hardwood and other trees 100 mm (4 in) and larger in meter to be retained on the project site.

(9) Fencing:

(a) Type and location (alignment), including location(s) and size of gates.

(b) Number of barbed wires on extension arm, where applicable.

(c) Height and type of fabric.

(d) Kind of posts and condition.

(e) General condition of fence as a whole.

(10) Endangered Species:

(a) Show location(s) of nesting or den trees.

(b) Prominently mark/identify trees for construction contractor's ease in preserving same during construction operations.

(11) Maps and Drawings: Copies of all existing and pertinent maps and "as-built" drawings, requested from and furnished by the Using Activity (DPW or BCE).

b. Obstruction Survey.

(1) Topographic map of prescribed area

(2) Elevations of all structures and topographic features

(3) Show all property lines and ownership

(4) Place tags on trees which are obstructions with the following information; recorded in standard field book and submit:

(a) Species of tree and diameter at breast high

(b) Ground elevation at base of tree

(c) Elevation of top of tree

(d) Obstruction number

c. Boundary and Easement Surveys.

(1) Monuments for control

(2) Ties to existing base lines, land corners, and installation or state coordinate system

(3) Property lines with metes and bounds

d. Safety Requirements. All Surveys. Locate and describe all features, and describe to the extent appropriate the existence of all features, constructed work, etc., which might constitute a hazard to construction contractor personnel who will work in the area.

e. Special Requirement for Utility Information on Topographic Survey. The chief of the party shall coordinate with the DPW/BCE concerning all utilities shown on the map sheets to insure that every effort has been made to obtain correct information. This is of prime importance in the case of underground primary and secondary utilities.

f. Field Check of Topographic Survey. When required by specific instructions during the completion of final design, conduct a field survey to determine the accuracy of the topographic sheets. Take sections where indicated on the drawings, marked in red, and the ground levels recorded at 30 m (100-foot) intervals and major break points. Take these cross sections at approximately 60 m (200-foot) intervals

unless otherwise shown, with a minimum of two cross sections to each topographic survey. Submit the original cross section check level notes with the survey data.

3.0 PREPARATION.

3.1 Topographic Drawings: Plot topographic and planimetric data to prescribed scale and contour interval on plastic, linen or polyester drafting film of approved quality IAW Norfolk District Drafting Standards and/or provide digital CADD file IAW instructions provided by the Norfolk District. When specific instructions are not furnished, the following applies:

- a. Show contours with fine, dashed line. Every fourth/fifth (guide) contour is somewhat heavier and periodically broken for insertion of the contour elevation. In general, identification of guide contours follows a regular pattern to allow for easy map reading.
- b. All survey stations, benchmarks, designations, and elevations are to be shown on topographic drawings.
- c. Show existing buildings structures with fine solid lines, omitting cross hatching or complete blanking. Indicate building number, function, type of construction and finish floor elevation.
- d. Orient maps and drawings so oriented that north is toward top of sheet, when practicable, or toward the left of the sheet if top orientation is impractical.
- e. Items to appear on all completed topographic drawings are as follows:
 - (1) North arrow.
 - (2) Grid ticks and values.
 - (3) Scale and graphic scale.
 - (4) Grid system, projection, and vertical datum with latter referenced to National Geodetic Vertical Datum (NGVD 1929 or 1988).
 - (5) Date of ground survey.
 - (6) Survey control points, identification, and elevations where appropriate.
- f. Use contour interval of 250 mm (1 ft) unless otherwise directed.
- g. The title block shall have no entries made therein except for the installation name and location, and the scale. To the left of the title block, a stamped and show a statement to the following effect:

Topographic Survey for (Specific Title of Survey)
by *(Name of Firm)* , surveyed *(Date of Survey)*

4.0 SUBMITTAL.

As soon as practicable after completion of the survey (i.e., with the first required submittal), submit the following documents to the District:

- a. Electronic disc and reproducible copies of the completed topographic survey maps. NOTE: The reproducible topography required by this paragraph is in addition to that required to be included in the contract drawings.

b. Original field notes and/or topographical sheets appropriately marked and dated. For original field data, separate horizontal and vertical control from other data to the maximum extent that is practical. Complete horizontal and vertical control sheets (furnished by the Government) for all permanent and semi-permanent points that are established by the survey. Provide a summary of the amount of misclosure and approximate length of traverse for each horizontal and vertical circuit.

---END OF CHAPTER---

CHAPTER 11

FIRE PROTECTION/LIFE SAFETY

1.0 GENERAL.

1.1 Scope. This appendix provides general guidance for the preparation and development of the Fire Prevention/Life Safety design.

1.2 Purpose. Fire Protection design is to establish optimum safeguards against loss of life and property by fire, consistent with the mission, risk involved, and economic utilization. Coordinate the design with the Architectural, Structural, Environmental, Civil, Electrical, and Mechanical sections of the design. Conform to the applicable standards contained in the Current National Fire Code, published by the National Fire Protection Association (NFPA), and other criteria referenced in paragraph: APPLICABLE PUBLICATIONS. In case of conflict between NFPA codes and criteria referenced hereinafter the following governs: for Army projects, the AEI; MIL-HDBK-1190 for Air Force projects; followed for both Army and Air Force by MIL-HDBK-1008C. The NFPA codes are not the final criteria for Fire Protection design unless the other referenced criteria so state or those criteria do not address an issue.

1.3 Qualifications of Fire Prevention Engineer. The design of Fire Protection features must be by a registered Professional Engineer or Registered Architect who is a full "Member" -in good standing- of the Society of Fire Protection Engineers (SFPE) or by an individual who is a registered Fire Protection Engineer and whose principle duties are Fire Prevention Engineering. The Fire Prevention Engineer must certify in written form that the design meets codes and criteria as applicable to the project under design. Submit the name and credentials (education and experience) of the Fire Prevention Engineer with the initial fee proposal. This information must be approved by the COE before issuance of the Notice to Proceed with design.

1.4 Required Design. A Fire Protection design is required and included in every project.

1.4.1 Design Analysis. A Fire Protection design analysis is required for every project and includes the following:

- a. Type of construction (including interior finish materials).
- b. Classification of occupancy.
- c. Building separation or exposure protection.
- d. Fire protection criteria.
- e. Location of all fire-rated walls including fire-rated doors and dampers with identification as to application (fire walls, fire partitions, and smoke partitions, with their resistive ratings).
- f. Life safety provisions (exit travel distances, exit unit widths based on the capacity and occupant load, horizontal exits, exit signs, and lighting).
- g. Automatic extinguishing system (identification of all sprinkled areas and areas protected by other automatic suppressions systems).
- h. Water supplies.
- i. Smoke control system. Provide smoke compartments and the requirements for smoke dampers, smoke detectors, and smoke partitions. Delineate the smoke control system by schematic diagram, when applicable, indicating the operations of the normal HVAC mode and the smoke removal mode.

j. Fire alarm system (type of alarm system and location of the fire alarm equipment, and the fire zones.)

k. Fire detection system (type of detection system and location of detectors, and fire zones.)

l. Location of fire extinguisher cabinets and fire hose standpipes.

m. Interior finish ratings.

1.4.2 Fire Prevention/Life Safety Drawing(s).

1.4.2.1 Submit a separate Fire Prevention/Life Safety floor plan drawing(s) for all projects that are:

- a. Places of assembly,
- b. Educational or institutional type facilities,
- c. Commissaries or any other buildings exceeding 930 square meters or 10,000 square feet in gross area or
 - Three stories or greater above grade, or
 - As required by the Specific Instructions.

1.4.2.2 Show at least the following items of interest to Fire Protection/Life Safety personnel on the drawings. Label the drawing(s) as reference only. A statement is to be made on the drawing that it is not part of the construction contract and that all information contained in it is called for elsewhere.

- a. Location and hourly rating of fire and smoke barriers (walls).
- b. Location of exits paths and the maximum travel distance of each.
- c. Fire hazard and occupancy classification.
- d. Building construction type as to its fire resistance capability .
- e. Exit units required and at each exit, the number of exit units available.
- f. Location of hand-held fire extinguisher and fire hose cabinets.
- g. Location and description of automatic sprinkler system.
- h. Location of building sprinkler entrance, back flow preventer, flow alarm, and post indicator valve (if required).
- i. Number of lps per square meter (gpm/sf) sprinkler system to each area.
- j. Location and notation of class of stand-pipe systems.
- k. Location of all smoke and fire detectors and a statement of their type.
- l. Location of manual pull boxes and audible/visual signaling devices.
- m. Location of fire alarm control panel.
- n. Description of any special fire protection features.

1.4.3 Fire Prevention Engineer's credentials. A copy of the Fire Prevention Engineer's credentials and the approval provided by the District's Fire Protection Engineer shall be a part of each required fire protection submittal.

1.5 Critical Projects. Projects identified as "Critical Projects" must have a complete, fully detailed design of all Fire Protection, Fire Detection, and/or Life Safety Systems. Critical Projects include the following facilities:

- a. Medical facilities.
- b. Aircraft maintenance and storage facilities.
- c. Engine test cells/areas.
- d. Missile assembly facilities/areas.
- e. Ordinance facilities or exposed explosive areas.
- f. Facilities which include significant data processing/telecommunications systems, as defined by AR 380-380.
- g. POL facilities.
- h. Flight simulators/Computer based training facilities.
- i. Warehouses with high piled or high rack storage.
- j. JSOC/SOTF facilities.
- k. Mission essential facilities.
- l. Any facility occupied (during normal working or sleeping times) by 100 or more persons.

2.0 APPLICABLE PUBLICATIONS.

Architectural and Engineering Instructions (AEI), Design Criteria.

MIL-HDBK-1008C Fire Protection for Facilities-Engineering, Design and Construction.

NFPA National Fire Codes (NFC).

3.0 PRE-CONCEPT/PRE-PROJECT DEFINITION (10%) SUBMITTAL REQUIREMENTS.

Code analysis indicating the general fire protection requirements.

4.0 CONCEPT/EARLY PRELIMINARY DESIGN SUBMITTAL REQUIREMENTS.

4.1 Design Analysis. A consolidated submittal is required to include features of paragraph 1.4.1. Comply with the requirements of this Chapter and Chapters 5, 6, 7, 8, and 9 of this Guide.

4.2 Fire Prevention/Life Safety Drawing(s). This drawing shall contain all the project features required in paragraph 1.4.2 for review. The drawing does not have to be in final form for this submittal. Include location, flow and pressures for existing hydrants if a fire sprinkler system is to be provided.

However, changes in content must not be made except at the direction of District technical personnel through the A-E.

4.3 Fire Prevention Engineer Certification. This submittal includes written certification by the A-E's Fire prevention Engineer that the design of the project meets all appropriate listed criteria.

4.0 SIXTY (60%) DESIGN SUBMITTAL REQUIREMENTS.

No requirements for this submittal.

5.0 FINAL DESIGN SUBMITTAL REQUIREMENTS.

5.1 Design Analysis. Develop the final Fire Protection design analysis from the design analysis submitted with the concept submittal. It is an updated version, not an amendment to earlier work. Incorporate all Fire Protection requirements, calculations, analysis, determinations, etc. required by all technical sections and chapters of this handbook and accurately reflect the final project design. Logically separate the submittal into sub-sections relating to the various technical disciplines involved.

5.2 Fire Prevention/Life Safety Drawing(s). This drawing(s) shall be complete and shall accurately reflect the final design features. Civil drawings shall locate fire hydrants, post indicator value (if required) and water flow/pressure data.

5.3 Fire Prevention Engineer Certification. The A-E's Fire Prevention Engineer shall certify the final design in written form. This is a separate certification from the required at the concept submittal. Include the certification in the Fire Protection design analysis submittal.

5.4 Specification.

5.4.1 Marked-up draft specifications and original manuscript project specifications, with electronic copy shall be submitted in accordance with Chapter 1, Automation Technical Management (Specifications, Drawings, Cost Estimates, Review Comments).

5.4.2 Specifications will not be restrictive. Generally, the description will be such that at least three manufacturers can meet the specified requirements. Do not use trade names in the specifications.

5.4.3 Specifications for fire suppression systems shall be CEGS adapted for the project. Components such as smoke detectors, heat actuated devices, and control panels for special systems shall be specified in the Fire Suppression specifications.

5.4.4 The subparagraphs on "Electrical Work" shall be carefully coordinated with the electrical section of the specifications. There shall be no conflicts as to which section covers starters, controls, or wiring, and no conflicts as to the type of starters required for the individual items of equipment.

6.0 CORRECTED CONTRACT DOCUMENT SUBMITTAL REQUIREMENTS.

6.1 Corrected submittals are not considered a formal design level, and are required only when the Final submittal must be revised or corrected due to errors or omissions.

6.2 Incorporate comments affecting Fire Protection/Life Safety generated during the Final Design review into the design analysis, specifications, and drawing(s) in the 100% submittal. Recertification by the Fire Prevention Engineer is required.

---END OF CHAPTER---

CHAPTER 12

COMPREHENSIVE INTERIOR DESIGN (C.I.D.)

1.0 GENERAL.

If included in the A-E contract, the C.I.D. includes selecting and developing interior building furnishings for an integrated visual design theme which reflects the interior atmosphere desired by the MACOM/MAJCOM and the Using Activity. The C.I.D. package must be developed concurrently with the design of the facility and submitted for review with the submittal per below. The C.I.D.

submittal includes:

- a. Statement of Design Objective
- b. Sketches
- c. Representative Furniture Layouts
- d. Sketch Perspectives
- e. Example Color Rendering
- f. Exterior C.I.D. Materials and Finishes
- g. Furnishing Illustration Sheets
- h. Cost Estimates
- i. Prewired Work Station Requirements
- j. Color Boards
- k. Furniture and Furnishings Plan
- l. Color Rendering
- m. Furnishings Placement Lists
- n. Furnishings Contract Specifications .
- o. Color Photographs of Recommended Furnishings

2.0 COMPREHENSIVE INTERIOR DESIGN.

Furnishings selected in the C.I.D. generally include, but are not limited to, artwork and wall hangings, drapery and upholstery, furniture and systems furniture, files and other similar items. (The use of prewired workstations (systems furniture) is mandatory for all Air Force administrative facilities and areas of 100 square meters or more per AF ETL 86-12.)

3.0 STRUCTURAL INTERIOR DESIGN (S.I.D.).

The C.I.D. requirements include structural interior design (S.I.D.) items and graphics. The S.I.D. includes interior materials and finishes such as color, texture, and patterns normally provided in the Architectural Design Requirements. Items include, but are not limited to, wall, ceiling and floor finish materials, window and door finishes, glazing and trim materials, as well as paint and stain samples. Since exterior colors, materials and finishes influence interior selections, include exterior materials as a separate section of the C.I.D.

4.0 CONCEPT/EARLY PRELIMINARY (30% SUBMITTAL FOR AIR FORCE – 35% SUBMITTAL FOR ARMY PROJECTS) SUBMITTAL.

If a C.I.D is required in Appendix A of the design contract, provide the following:

- a. Statement of Design Objectives. Provide a narrative explaining the interior design philosophy of the facility. Where applicable, include desired psychological impact of the interior environment on its inhabitants and proposed method of accomplishing same by using space planning, shapes, forms, color, patterns, textures, fabrics and furnishings. Discuss plans to integrate the visual design disciplines such as architecture, graphic design, and interior design.

- b. Sketches. These drawings illustrate the major spaces within the facility and shall emphasize form, space and detailing. Color is not required for these sketches.
- c. Representative Furniture Layouts. Show how major spaces within the facility integrate the C.I.D. and S.I.D. Include a furnishings placement plan for each of the major spaces and a furnishings illustration sheet for each item provided.
- d. Sketch Perspectives. Provide a single-line sketch perspective of each major space within the facility showing three dimensional space relationships and furnishings. This requirement is in addition to any single elevation sketches.
- e. Example Color Rendering. Provide an example color rendering of a major space for approval. The rendering shall be prepared by a professional artist.
- f. Exterior S.I.D. Materials and Finishes. Include wall finish materials, window and door frames, glazing, and trim materials. Provide paint or stain samples representing color and finish of gravel stops, fascias, hand rails, hardware, ventilation grills, screen walls, penthouses, and other visible materials affecting visual design aesthetics.
- g. Furnishings Illustration Sheets. Provide illustrations and material/color samples of upholstery for each furnishing item proposed in the interior design scheme. Illustrations are to be represented by photograph, catalog cut, sketch, or rendering. The material/color samples provided must be large enough to indicate true patterns, colors, and textures.
- h. Cost Estimates. Submit a furnishings cost estimate for the facility as required in of the design contract. Show class number, fund category, item, quantity, unit cost, and total cost. Use a 10% contingency figure, and break out freight costs as a separate figure on each item. Include the cost estimate in the overall CWE as a line item also.
- i. Color Boards. If required at this stage, see 60% Design C.I.D. requirements.
- j. Prewired Work Stations Requirements. For Air Force projects provide Program Management Data Sheet and Acquisitions Cost Space Requirement Summary Worksheets per AF ETL 86-12.

5.0 SIXTY PERCENT (60%) DESIGN SUBMITTAL REQUIREMENTS.

Update and complete all information provided in previous submittals and provide the following:

- a. Color Board. The color .board shall depict all C.I.D./S.I.D. materials and finishes. Code and coordinate samples with the finish, color, and graphics schedules of the facility contract documents. Label the material and finish samples with specific color names. Pattern samples shall be large enough to show the full pattern, color, and texture. Furniture samples shall also be located on the furnishing plan. Securely mount samples to the color board modules to withstand long periods of use. Provide color boards in 8 ½ " x 11" format in binders.
- b. Furniture and Furnishings Plan. Provide a "footprint" plan showing the furnishings required for the various functions that are to be housed in the facility, and indicating the adequacy of the size and shape of each space. Use standard furniture sizes to allow maximum flexibility for the final design. Locate and identify accent walls, graphics, wall hangings and special feature items on this plan, and codify furnishings to the "Furnishings Illustration Sheets."
- c. Color Rendering. Provide a colored interior perspective rendering of a major space showing three dimensional space relationships, furnishings, color schemes, patterns and materials. The rendering shall be prepared by a professional artist. See the chapter on renderings for additional requirements for submittals and copies.

d. Furnishings Placement Lists. Provide a coded floor plan and detailed listing of the furnishings specified for each room. Provide a separate list with coded floor plan for each room. A floor plan with 1:50 (1/4" = 1'); 1:100 (1/8" = 1') scale may be used for large areas only if data is legible at reduced sizes. Show the following:

1. Proposed furniture placement or location coded by number and letter to indicate item and finish.
2. Structural related built-in equipment, identified by name and finish code.
3. Identifying labels per list headings to allow reviewer, as well as handling and moving personnel to quickly identify and locate the furniture listed.
4. For series of rooms calling for the same number of identical furnishings and same finishes, one placement list may be provided for all rooms listed. This list should duplicate the required number of times to represent each room. Number each page in proper sequence with room numbers circled.

e. Furnishings Contract Specifications. When appropriate, name a commercial product with desired colors, finishes and detailed functional requirements as a standard to select from. Include a general non-proprietary disclaimer to indicate that naming the commercial product is not to be restricted to the particular product identified. Each furnishing item selected must be available from at least three manufacturers. Recommended specifications for prewired workstations are included in AF ETL 86-12.

6.0 FINAL DESIGN SUBMITTAL.

Update and complete all information provided in previous submittals and approved review comments. If a 60% submittal was not required in the A-E contract, the information requested in that section must be provided with the Final submittal.

7.0 CORRECTED CONTRACT DOCUMENT SUBMITTAL.

Update and complete all information provided in previous submittals and respond to review comments.

----END OF CHAPTER---

CHAPTER 13

RENDERINGS

1.0 PRE-CONCEPT/PRE-PROJECT DEFINITION (10%) SUBMITTAL REQUIREMENTS.

1.1 Single Line Perspective. The exterior perspective show three dimensional aspects of the facility with emphasis on the main building features. The perspective illustrates the view planned for the final colored rendering for MACOM/MAJCOM and Using Activity approval.

2.0 CONCEPT/PROJECT DEFINITION (30%) SUBMITTAL REQUIREMENTS.

If a 10% submittal was not made, provide the Single Line Perspective described above and also the following:

2.1 Sample Rendering. Five (5) copies of 200 mm x 250 mm (8 in x 10 in) photo colored rendering to be used for the final perspective rendering for MACOM/MAJCOM and Using Activity approval. Note: Marker or computer generated renderings are not acceptable unless previously approved by the District.

3.0 PRELIMINARY (60%) AND/OR FINAL SUBMITTAL REQUIREMENTS.

3.1 Colored Perspective Rendering. A 500 mm x 750 mm (20 in x 30 in) framed sized painted rendering prepared by a professional architectural artist showing the view in the approved Single Line Perspective and illustrating the colors and patterns of exterior building materials. Provide original. It shall be framed, double matted and provided with non-glare acrylic glazing as the face protection.

3.2 Site Photos. Show adjacent sites, buildings and site construction conditions by providing a small scale site plan and a minimum of six (6) 125 mm x 175 mm (5 in x 7 in) color photos viewing 360 degrees around the building site. Code and locate photo views on the site plan. Provide 125 mm x 175 mm (5 in x 7 in) close-up frontal views of significant buildings that can be viewed from the site. For rehabilitations and additions, show elevations of existing buildings.

4.0 CORRECTED CONTRACT SUBMITTAL REQUIREMENTS

4.1 Colored Perspective Rendering. Provide any revisions required to the original rendering. Provide original and three (3) full size photographic copies. These shall be dry mounted, double matted, framed and provided with non-glare acrylic glazing as face protection, ready for hanging.

4.2 Color Photographs. Provide five (5) color photos (200 mm x 250 mm (8 in x 10 in) and two (2) 35 mm color slides of the final rendering with one (1) 100 mm x 125 mm (4 in x 5 in) negative of each rendering.

----END OF CHAPTER---

CHAPTER 14

MECHANICAL AND PLUMBING DESIGN

1.0 GENERAL: This chapter provides guidance for preparation and development of the following design aspects: heating, ventilating, air conditioning (including dx systems, chilled water systems, and dual temperature systems), plumbing (including compressed air, and medical gas systems), fuel gas, fuel oil, fire suppression systems, central energy plants, and associated systems and subsystems. Designs of systems for hardened structures has not been addressed in this chapter, see TM 5-855-4.

1.1 Basic Design Criteria -- HVAC and Plumbing Systems: Architectural and Engineering Instructions, current edition, and TM 5-810-1, current edition; are the prime design manuals for Army projects. For Air Force projects the prime design manual is MIL-HDBK-1190. In case of conflict between criterias, the AEI, current edition, shall govern for Army Projects.

1.2 Basic Design Criteria -- Sprinkler Systems: Architectural and Engineering Instructions, current edition, the MIL-HDBK-1008C, and NFPA Fire Codes are the prime design manuals for Army projects. For Air Force projects the prime design manual is MIL-HDBK-1008C except as modified herein. In case of conflict between criterias, the MIL-HDBK-1008C shall govern for Army Projects, unless the NFPA requirements are more stringent.

2.0 APPLICABLE PUBLICATIONS: The most current editions of the publications listed below shall be included in this chapter whenever referenced or applicable.

2.1 Architectural and Engineering Instructions

Design Criteria – TI 800-01, Jul 1998
Family Housing - TI 801-02, Oct 2000

2.2 Military Handbook

MIL-HDBK-1008C	Fire Protection for Facilities - Construction	Engineering, Design, and
MIL-HDBK-1190	Facility Planning and Design Guide	

2.3 American National Standards Institute (ANSI)

B31.1 Power Piping

2.4 National Association of Plumbing-Heating-Cooling Contractors (NAPHCC)

National Standard Plumbing Code (Current)

2.5 American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Inc.

Latest	Applications
Latest	Equipment
Latest	Systems
Latest	Fundamentals
Latest	Refrigeration

2.6 Department of the Navy

DM-22 Design Manual for Petroleum

3.0 Use of Standard Designs or Site Adaptations

a. Consultant is required to provide complete design analysis, specifications, and drawings specific to the project which is under design. Designers may utilize "standard plans" at his/her option, but in no case will the use of standard plans excuse the consultant from providing a complete, workable, realistic, economical design package.

b. Life Cycle Cost Studies and Energy Budget calculations may or may not be required for projects using standard designs or site adaptations. The Designer should contact the Technical Manager and the Chief of the Mechanical/Electrical Section to review specific project requirements.

c. Whether a site adaptation or a standard design, the Designer is responsible for bringing the design into compliance with current criteria. Of particular interest is ventilation air for occupant comfort.

4.0 REQUIREMENTS AND MANAGEMENT PLAN [RAMP] (AIR FORCE PROJECTS ONLY)

The A-E may be tasked with providing a RAMP document for an Air Force project. RAMP development is a non-standard design feature and shall be specifically addressed in the scope of work if it is required. As a minimum the RAMP document shall contain the following items:

- a. A detailed 1391 which will include an approved site plan, floor plan, scope, and environmental certificate of compliance.
- b. Site Plan at 1:50 ft scale.
- c. Long Range Plan.
- d. Unique project criteria and requirements.
- e. Air Combat Command Definitive or Site Adapt (if available)
- f. Site Utility Drawings with capacities and connection points for water, domestic/industrial wastes, gas, stream, electric power, communications, control, traffic flow, and special site conditions.
- g. Base design guide or standards.
- h. User/Base Civil Engineer POC's and telephone numbers.
- i. Draft copy of the Project Management Plan.

5.0 PROJECT DEFINITIONS (10%) SUBMITTAL REQUIREMENTS (AIR FORCE PROJECTS ONLY)

This submittal is only required for Air Force Projects. There are no formal submission requirements for HVAC systems or interior plumbing systems at this stage, however, any asbestos removal costs must be included in the parametric cost estimate which is required to be submitted with this submission.

6.0 PRECONCEPT (15%) SUBMITTAL REQUIREMENTS (ARMY PROJECTS)

There are no standard formal submission requirements at this stage for mechanical/plumbing systems. Fire protection design analysis should be included in this submission.

7.0 CONCEPT/EARLY PRELIMINARY DESIGN SUBMITTAL REQUIREMENTS

(30% SUBMITTAL FOR AIR FORCE PROJECTS - 35% SUBMITTAL FOR ARMY PROJECTS)

7.1 Concept/Early Preliminary Design Analysis: The narrative will form the basis of the future Final Design Analyses as required by later paragraphs in this document. The narrative shall include at least the following items:

a. Heating, Ventilating, and Air Conditioning:

(1) Criteria Listings/Basis of Design - technical manuals, pamphlets, technical books, ETLs, etc.

(2) Design Conditions used in the calculations - inside and outside temperatures, personnel load, equipment heat release (if applicable), outside air and/or ventilation requirements, U-Factors, and other special conditions.

(3) Block heating and cooling loads - for manual calculations standard ASHRAE calculation forms shall be used, either residential or commercial as applicable. If computer-generated-loads software is utilized for the loads the Designer must include sketches of the building in the design analysis describing the zoning used and a narrative explaining the zone choices. Additionally, complete input data must be provided (note: where the computer input data is not self-explanatory, the Designer shall annotate the data to explain/support the data).

(4) Life Cycle Cost System Selection Study - unless specifically removed from a particular project, ALL new HVAC systems shall be selected through the completion of a life cycle cost study. Study shall be in accordance with the requirements of TM 5-802-1. The program LCCID (Life Cycle Cost In Design) is an acceptable computer based program for the economics portions of the study. Study shall include at least three realistic distinct alternatives. A narrative description of each system studied shall be included. All cost information (energy, initial, maintenance, replacement) must be clearly presented and included in the study.

(5) Energy Budget Calculation - Energy budget calculation must be done in accordance with Chapter 15 of this Manual and the AEI Chapter 11 requirements. Buildings which cannot comply with the prescribed Energy Budget shall be redesigned to incorporate energy conservation features as necessary until the calculated budget complies with the required budget target. The Design Energy Budgets contained in the AEI are considered absolute maximums and no consideration will be given to designs which do not comply. Energy Budget calculations shall include a complete list, table, and/or tabulation of the computer input and output data used as well as a narrative explanation of the procedure and model used. Energy Budgets which contain unrealistic predictions of energy usage will be returned to the Engineer for rework and resubmission.

(6) Brief description of various items of equipment to be used. Indicate expected operating temperatures and capacities.

(7) Brief description of piping systems including types of pipe, insulation requirements, and whether concealed or exposed.

(8) Description of mechanical demolition required - include suspected asbestos, lead paint, or other controlled items.

(9) Army projects require full-size (E Size) plans, Air Force projects require 8 1/2" x 11" plans bound into the submittal book. Plan shall show floorplan including:

a. Room Names

- b. Major Equipment Locations
(Interior and Exterior)
- c. Single-Line Ductwork Layout
- d. Service Entries
- e. Maintenance Clearance for all Major Equipment Items
- f. Piping Mains (Locations and Approx. Size)

(10) An itemized list of any additional criteria, guidance, or clarification required.

(11) Additive or cost reduction items (if applicable).

b. Plumbing:

(1) Criteria listing - manuals, codes, etc.

(2) Plumbing Calculations - Calculations required:

- a. Domestic Water Main Sizing
- b. Hot Water Heater Sizing
- c. Sanitary Waste Main Sizing
- d. Building Population (if available)

(3) Description of Water Heating System - include storage capacity, recovery capacity, equipment location, fuel (elec, gas, oil, boiler water). Life Cycle Cost Justification of the hot water heating system shall be provided when identified in the scope of work.

(4) Piping types and locations (concealed or exposed) and materials proposed and insulation levels.

(5) Brief description of miscellaneous systems such as, compressed air, roof drainage, natural gas, medical gas, and other special systems.

(6) Description of plumbing demolition required. Include information on any asbestos, lead paint or other controlled items expected to be encountered.

(7) An itemized list of any additional criteria, guidance, or clarification required.

(8) Plumbing drawings are not required at this stage. Domestic water heater location shall be shown on the mechanical concept plan.

c. Fire Protection System:

(1) Criteria listing - Except as modified in writing, fire protection criteria shall conform to the requirements of the Architectural and Engineering Instructions, MIL-HDBK-1008C, NFPA-13, and to other applicable standards contained in the National Fire Codes as published by the National Fire Protection Association (NFPA). In cases of conflict between NFPA-13 and MIL-HDBK-1008B, the Mil Handbook shall govern.

- (2) Listing of the hazard classification for each space and discussion of protection requirements for specific hazards.
- (3) Discussion of fire protection features to reflect types of systems considered with a brief description of each.
- (4) If sprinkler systems are to be installed, provide preliminary hydraulic calculations to determine the adequacy of the existing water service. If a fire pump is required, a preliminary size shall be submitted at this stage.

d. Other:

- (1) If underground fuel oil storage is proposed for use the Designer shall include preliminary tank sizing calculations and a discussion of the spill/leak detection systems to be utilized.
- (2) Life Cycle Cost Studies and Energy Budgets are separate analyses. Analyses runs used for the Life Cycle Cost Analysis Simulations are not applicable for Energy Budget Analysis Simulations. Energy Budget Analysis Simulations should be done separately.
- (3) A list of CEGS guide specifications, see CCB or TECHINFO, Specifications for further information.
- (4) The A-E shall include in the submittal a completed mechanical room certification form. This form shall be prepared by the Architect of Record and the Mechanical Consultant (where applicable). Following completion of submission review, the mechanical systems reviewer will verify accuracy of the information and countersign the form. A sample form is attached to this Chapter as Exhibit 1.

8.0 SIXTY PERCENT (60%) DESIGN SUBMITTAL REQUIREMENTS (Air Force Projects Only)

8.1 Design Analysis

8.1.1 The Design Analysis shall contain all items indicated to be included in the Concept Design Analysis incorporating any required revisions. In addition, the following items shall also be included:

a. Heating, Ventilating, and Air Conditioning:

- (1) Calculations for heating and cooling loads shall be made in accordance with the current ASHRAE Fundamentals Handbook recommendations. Standard ASHRAE calculation forms (or similar local forms) shall be used for all manual calculations. Automated (Computer Based) load calculation programs may be used provided the software is ASHRAE-based. Load calculation programs other than 'Carrier Hourly Analysis Program', 'Trane Trace' or UASCE CERL BLAST (Building Loads Analysis and System Thermodynamics) Program shall be approved in advance by the Norfolk District prior to their use. Load calculation safety factors shall be as indicated in the AEI or TM 5-810-1.
- (2) Boiler sizes shall be based on calculated heat load, safety factors, piping losses, and pickup requirements. Selection of boilers shall be based on "gross" rating. List in the design analysis allowances made for safety factors, piping losses, etc.
- (3) Mechanical Ventilation - When calculating fan capacities for ventilation purposes, show in the Analysis the volume of the space to be ventilated and the number of air changes to be provided. If the fan capacity is to be based on heat generated in the space, show all assumptions made along with the calculations.

(4) Equipment Selections - The design analysis shall include calculations to support the selection of equipment and shall generally show a minimum of three make and model number selections for each item of equipment considered during the design analysis phase. Equipment spaces and equipment arrangements shall be such that not less than three different sources of equipment are available. Sole source specification shall be avoided.

(5) Air Balance - The design analysis shall include a complete facility air balance which will identify all passive and active exhaust and intake air systems for the facility. Designer shall review, analyze, and report this data to support the design presented.

(6) Outdoor Air Requirements - The design analysis shall include a separate tabulation of the outdoor air provided into the building in direct support of the building population and not required by processes contained within the building. Designer shall comply with ASHRAE 62, latest edition, or any other more stringent criteria specifically provided.

b. Exterior Distribution:

(1) Exterior hot and chilled water distribution piping shall be sized for this submittal. The analysis shall show quantities, pipe sizes, pressure drops, and initial and final pressures.

c. Plumbing System:

(1) Design Analysis shall include all calculations as required for the concept submittal with corrections and revisions as required by review comments generated.

d. Fire Protection System:

(1) Provide a detailed description of the system and its controls such as activation, HVAC Systems interlocks, and connection to the fire alarm and detection system.

(2) For all water-based sprinkler systems protecting facilities exceeding 3000 square feet, sprinkler systems shall be designed by hydraulic analysis in accordance with NFPA-13 and MIL-HDBK 1008C. Designer shall include all necessary design parameters on the drawings.

(3) Detailed descriptions of special systems, paint spray booths, kitchen exhaust hoods, etc.

e. HVAC Controls & EMCS:

(1) Submittal shall include a detailed description of the proposed HVAC controls systems in accordance with the requirements of TM 5-815-3. Where post-wide EMCS systems are existing, design shall provide for complete interface capability.

f. Concept Review Comments with Written Responses - ARMS Format or green pencil annotations on the original comment sheets.

8.2 Drawings

The drawings shall show all information given on the Concept Plans except in greater detail. In addition, the drawings shall include at least the following:

a. Floor plan layouts showing location of all items of mechanical equipment, piping, ductwork, and fixtures. Floor plans shall also include room names and/or room numbers.

b. Enlarged Plan of Mechanical Equipment Room(s) - Equipment room layouts shall be sufficiently complete to show piping and duct layouts, equipment locations, and required access for maintenance. Plan shall also include locations of electrical switchgear and/or panels, telephone panels, fire alarm

panels and other electrical equipment whose location and/or clearance requirements affect the mechanical design. A minimum of 24 inches working clearance shall be provided around all major equipment items while depicting the largest of at least three suitable manufacturers standard unit dimensions. Minimum scale for mechanical room plans will be 1/4"=1'-0". Sections of the mechanical room are not specifically required at this submission stage but may be provided at the option of the designer.

c. Double line layout of all ductwork inside the building. Piping layouts shall be single line. Detailed piping schematic diagrams or risers, elevations, sections, and/or details are required as necessary to establish design parameters or intent. Riser diagrams may be partially developed at this submission level.

d. Equipment capacities shall be shown on schedules. Schedules shall all be located on a single sheet. Coordinate electrical requirements with the electrical designer. Trade name or "or equal" specifications for equipment shall not be used.

e. Plumbing fixture schedule listing all fixture types to be included in the project. Schedule shall include a listing for hot water, cold water, waste, and vent piping for each individual fixture and any other special requirements.

f. Heat distribution plan (if applicable) showing location and sizes of lines and pits, pit equipment and capacities, grading of lines, location of anchors and supports.

g. Electrical characteristics for all mechanical equipment shall be indicated in the equipment schedules. Efficiencies shall be included for pumps, air conditioning equipment, boilers, furnaces, etc.

h. Location of equipment, piping, and ductwork shall be completely coordinated with all other features of the project - architectural, structural, electrical, etc.

i. Ensure that all ventilation intakes are located to preclude entrance of exhaust air into the fresh air intakes.

j. Fire Protection Drawings-Unless specifically indicated otherwise in the scope of work, complete fire protection drawings showing all sprinkler heads, risers, piping, and details are not required. The contractor shall be required to provide the complete sprinkler design, including hydraulic calculations, at submittal after award. Contract drawings shall include at least the following items:

- (1) Existing water supply system characteristics
- (2) Occupancy classifications for all spaces
- (3) Design Densities for all spaces
- (4) Design Areas to be used for the hydraulic calculations
- (5) Building zoning
- (6) Riser location
- (7) Hose Stream Demands
- (8) Fire Pump Locations (if applicable)
- (9) Riser Pipe Detail

(10) Fire Pump Piping Schematic and Size

k. Heat distribution, liquid fuel distribution, chilled water distribution, steam and condensate distribution drawings shall have complete profiles provided for the entire length of run except when the run is less than 50 feet. Details of pits, drips, drip points, etc. will be shown.

l. Controls Drawings - Temperature controls drawings shall show at least the following items:

- (1) Locations of sensors, thermostats, and control panels
- (2) Control Schematics and Ladder Diagrams
- (3) Controls Legend
- (4) Complete Sequence of Control
- (5) Identification of all Control Devices
- (6) Setpoints, action, etc. for all Control Devices
- (7) Control Panel Layout

8.3 Specifications

a. Outline guide specifications shall be provided. Specifications shall not be in final typed format at this stage.

b. Specifications are not normally proprietary in nature nor do they typically include manufacturer's names and model numbers. Refer to Chapter - Specifications, for more information as to when and why proprietary or 'or equal' specifications may be utilized.

9.0 FINAL DESIGN SUBMITTAL REQUIREMENTS **(90% SUBMITTAL AIR FORCE - 100% SUBMITTAL ARMY)**

9.1 Design Analysis

9.1.1 The Design Analysis shall contain all items indicated to be included in the Concept Design Analysis incorporating any required revisions. In addition, the following items shall also be included:

a. Heating, Ventilating, and Air Conditioning:

- (1) Calculations for heating and cooling loads shall be made in accordance with the current ASHRAE Fundamentals Handbook recommendations. Standard ASHRAE calculation forms (or similar local forms) shall be used for all manual calculations. Automated (Computer Based) load calculation programs may be used provided the software is ASHRAE-based. Load calculation programs other than USACE CERL BLAST (Building Loads Analysis and System Thermodynamics) Program or DOE 2.1 shall be approved in advance by the Norfolk District prior to their use. Load calculation safety factors shall be as indicated in the AEI or TM 5-810-1.
- (2) Boiler sizes shall be based on calculated heat load, safety factors, piping losses, and pickup requirements. Selection of boilers shall be based on "gross" rating. List in the design analysis allowances made for safety factors, piping losses, etc.
- (3) Mechanical Ventilation - When calculating fan capacities for ventilation purposes, show in the Analysis the volume of the space to be ventilated and the number of air changes to be

provided. If the fan capacity is to be based on heat generated in the space, show all assumptions made along with the calculations.

(4) Pump head calculations, fan external and total static pressure calculations, building air balance calculations, equipment sizing calculations and all other calculations or documentation required to completely support the presented design shall be included in the design analysis.

(5) Equipment Selections - The design analysis shall include calculations to support the selection of equipment and shall generally show a minimum of three make and model number selections for each item of equipment considered during the design analysis phase. Equipment spaces and equipment arrangements shall be such that not less than three different sources of equipment are available. Sole source specification MUST be avoided.

(6) Air Balance - The design analysis shall include a complete facility air balance which will identify all passive and active exhaust and intake air systems for the facility. Designer shall review, analyze, and report this data to support the design presented.

(7) Outdoor Air Requirements - The design analysis shall include a separate tabulation of the outdoor air provided into the building in direct support of the building population and not required by processes contained within the building. Designer shall comply with ASHRAE 62, latest edition, or any other more stringent criteria specifically provided.

b. Exterior Distribution:

(1) Exterior hot and chilled water distribution piping shall be sized for this submittal. The analysis shall show quantities, pipe sizes, pressure drops, and initial and final pressures.

(2) Expansion Loop Calculations - Expansion loop sizes shall be calculated for steam and hot water distribution systems. Designs shall comply with the recommendations of ANSI B31.1. Loops shall generally be formed of equal length leg segments.

c. Plumbing System:

(1) Design Analysis shall include all calculations as required for the concept submittal with corrections and revisions as required by review comments generated.

d. Fire Protection System:

(1) Provide a detailed description of the system and its controls such as activation, HVAC Systems interlocks, and connection to the fire alarm and detection system.

(2) For all water-based sprinkler systems protecting facilities exceeding 3000 square feet, sprinkler systems shall be designed by hydraulic analysis in accordance with NFPA-13 and MIL-HDBK-1008C. Designer shall include all necessary design parameters on the drawings.

(3) Detailed descriptions of special systems, paint spray booths, kitchen exhaust hoods, etc.

e. HVAC Controls & EMCS:

(1) Submittal shall include a detailed description of the proposed HVAC controls systems in accordance with the requirements of TM 5-815-3. Where post-wide EMCS systems are existing, design shall provide for complete interface capability.

f. Concept Review Comments with Written Responses - ARMS Format or green pencil annotations on the original comment sheets.

9.2 Drawings

The drawings shall show all information given on the Concept Plans except in greater detail. In addition, the drawings shall include at least the following:

- a. Floor plan layouts showing location of all items of mechanical equipment, piping, ductwork, and fixtures. Floor plans shall also include room names and/or room numbers.
- b. Enlarged Plan of Mechanical Equipment Room(s) - Equipment room layouts shall be sufficiently complete to show piping and duct layouts, equipment locations, and required access for maintenance. Plan shall also include locations of electrical switchgear and/or panels, telephone panels, fire alarm panels and other electrical equipment whose location and/or clearance requirements affect the mechanical design. A minimum of 24 inches working clearance shall be provided around all major equipment items while depicting the largest of at least three suitable manufacturers standard unit dimensions. Minimum scale for mechanical room plans will be 1/4"=1'-0". Sections of the mechanical room shall be provided to indicate equipment installation and coordination requirements.
- c. Double line layout of all ductwork inside the building. Piping layouts shall be single line. Detailed piping schematic diagrams or risers, elevations, sections, and/or details are required as necessary to establish design parameters or intent.
- d. Equipment capacities shall be shown on schedules. Schedules shall all be located on a single sheet. Coordinate electrical requirements with the electrical designer. Trade name or "or equal" specifications for equipment shall not be used.
- e. Plumbing fixture schedule listing all fixture types to be included in the project. Schedule shall include a listing for hot water, cold water, waste, and vent piping for each individual fixture and any other special information.
- f. Heat distribution plan (if applicable) showing location and sizes of lines and pits, pit equipment and capacities, grading of lines, location of anchors and supports.
- g. Electrical characteristics for all mechanical equipment shall be indicated in the equipment schedules. Efficiencies shall be included for pumps, air conditioning equipment, boilers, furnaces, etc.
- h. Location of equipment, piping, and ductwork shall be completely coordinated with all other features of the project - architectural, structural, electrical, etc.
- i. Riser diagrams (isometric or flat) of soil, waste, drain, domestic water, and vent stacks shall be shown on the drawings.
- j. Ensure that all ventilation intakes are located to preclude entrance of exhaust air into the fresh air intakes.
- k. Fire Protection Drawings-Unless specifically indicated otherwise in the scope of work, complete fire protection drawings showing all sprinkler heads, risers, piping, and details are not required. The contractor shall be required to provide the complete sprinkler design, including hydraulic calculations, at submittal after award. Contract drawings shall include at least the following items:

- (1) Existing water supply system characteristics
- (2) Occupancy classifications for all spaces
- (3) Design Densities for all spaces

- (4) Design Areas to be used for the hydraulic calculations
- (5) Building zoning
- (6) Riser location
- (7) Hose Stream Demands
- (8) Fire Pump Locations (if applicable)
- (9) Riser Pipe Detail

(10) Fire Pump Piping Schematic and Size

l. Heat distribution, liquid fuel distribution, chilled water distribution, steam and condensate distribution drawings shall have complete profiles provided for the entire length of run except when the run is less than 50 feet. Details of pits, drips, drip points, etc. will be shown.

m. Controls Drawings - Temperature controls drawings shall show at least the following items:

- (1) Locations of sensors, thermostats, and control panels
- (2) Control Schematics and Ladder Diagrams
- (3) Controls Legend
- (4) Complete Sequence of Control
- (5) Identification of all Control Devices
- (6) Setpoints, action, etc. for all Control Devices
- (7) Control Panel Layout

n. Details and Sections - Drawings shall include typical and especially atypical details and building sections as necessary to completely support the presented design. Typical details to be included:

- (1) Suspension details for equipment which is supported from above
- (2) Coil piping details
- (3) Diffusers, Register, Grille
- (4) Pump piping diagram
- (5) Concrete support pads for mechanical equipment
- (6) Cooling tower support details
- (7) Equipment piping details
- (8) Condensate drainage details
- (9) Fire damper details

- (10) Equipment installation details (unit heater, fin tube radiation, exhaust fans, range hoods, etc.)

9.3 Specifications

- a. Marked-up [pencil edited] CEGS guide specifications shall be provided. Specifications shall not be in final typed format at this stage.
- b. Specifications are not normally proprietary in nature nor do they typically include manufacturer's names and model numbers. Refer to Chapter - Specifications, for more information as to when and how proprietary or 'or equal' specifications may be utilized.
- c. Specification coordination between the various Sections and disciplines shall be accomplished prior to submission.
- d. Particular care should be taken when the Guide Specifications provide multiple choices for control or accessories. Designer shall investigate and determine applicable choices for all options.

10.0 CORRECTED CONTRACT DOCUMENTS SUBMITTAL **(ARMY AND AIR FORCE PROJECTS)**

10.1 General Procedure

- a. Backcheck submittal (corrected final) shall include a written response to all design review comments generated at final design review. Design documents shall incorporate all required changes identified during the review.
- b. Mechanical submission requirements shall include:
 - (1) Corrected Drawings
 - (2) Corrected Design Analysis (if applicable)
 - (3) All Previous Comments and Responses
- c. Failure to resolve all project review comments and incorporate solutions may lead to additional reviews. This will reflect negatively in A-E Performance Evaluations.

11.0 NORFOLK DISTRICT SPECIFIC DESIGN CRITERIA

11.1 General Scope of Mechanical Designs - Mechanical work shall include, but is not limited to, the design of the following items:

- a. Air Conditioning Systems
- b. Compressed Air Systems
- c. Medical Gas Systems
- d. Emergency Engine-Generator Units
(Shared responsibility with Electrical Designer)
- e. Fire Suppression Systems (Sprinklers, etc)
- f. Gas Piping Systems

- g. Heating Systems
- h. Ventilation Systems
- i. Mechanical Equipment Systems
- j. Plumbing Systems (Water, Waste, Vent)
- k. Refrigeration Systems
- l. Chilled and Hot Water Distribution Systems
- m. Steam Distribution Systems
- n. Liquid Fuel Storage and Dispensing Systems
- o. HVAC Controls Systems
- p. Life Cycle Cost Systems Selection Studies
- q. Medical Waste Systems
- r. Seismic Protection Systems (For Mechanical Systems)
- s. Energy Budget Calculations

11.3 Coordination of Work

11.3.1 Coordinate space requirements, foundations, supports, duct and pipe routing, electrical service, electrical equipment, and associated architectural, structural and civil design elements.

11.3.2 Coordinate exterior distribution systems with utility systems and site work requirements.

11.3.3 All piping and ductwork shall be concealed in habitable spaces in all Army and Air Force Facilities, except storage and service facilities, utility, and medical storage spaces in hospitals.

11.3.4 Neither HVAC ductwork nor piping nor plumbing piping shall transverse over or under electrical panels or switchboards.

11.4 Supplementary TM Manuals and Engineering Technical Letters (ETL) - Additional technical manuals and technical letters will be requested by the Designer from the District Technical Manager. Designer shall first verify that the requested technical manuals or technical letters are not available from the 'Specsintact' system used for development of project specifications. These manuals and letters will supplement basic criteria.

11.5 Guide Specifications - The appropriate sections of the specifications shall be edited by the designer as appropriate. Designers shall pay particular attention to the TECHNICAL NOTES included in the specifications and shall edit the specification accordingly. The specifications and notes contained therein contain information and requirements that must also be included in the design documents or drawings. Terminology on the drawings and in the specifications shall be the same.

11.6 Review Comment/Response Format - Norfolk District is currently utilizing DrChecks System for the preparation of design review comments and responses. There is no fee for this program.

11.7 HVAC System Selection

11.7.1 Full consideration shall be given to achieve greater operating economics by the use of one or more proven energy conservation methods. Life Cycle Cost System Selection Studies and Energy Budget calculations shall be provided for ALL new and major rehabilitation projects. (For site adapt projects and/or standard designs contact the Chief Norfolk District Mechanical/Electrical Section for guidance.) Scope of Work will address the need for an Energy Budget Calculation and Life Cycle Cost System Selection Study (LCCA).

11.7.2 In design and selection of alternate systems to investigate, the environmental requirements of the facility shall be carefully analyzed. Any system may be analyzed with the exception of electric heat, reheat systems, or other systems directly prohibited by the AEI or TM 5-810-1. A computerized energy analysis is required unless specifically excluded from the Scope of Work.

11.7.3 Existing system repair, one-for-one replacement, or extensions will not require a Life Cycle Cost Analysis. Equipment installed and construction modified will be brought up to meet the current criteria requirements.

11.8 Standard Systems Criteria

11.8.1 Outside design temperatures shall be taken from TM 5-785, Engineering Weather Data, for Army and Air Force Projects. These conditions shall be used unless written instructions to the contrary are provided to the Designer.

11.8.2 Inside design conditions shall be as indicated in TM 5-810-1.

11.8.3 Year Round Cooling Requirements: If an air conditioning system serves an area having high internal heat gains (such as ADP areas), consideration must be given to possible year round cooling requirements and the system designed accordingly.

11.8.4 Facilities designated as "critical facilities" shall be provided with redundant systems. Where only a part of a facility is considered critical, consideration shall be given to using the systems for the rest of the facility as the 'redundant' system for the critical areas.

11.8.5 Fire Protection

11.8.5.1 The current requirements of the AEI, CEGS Guide Specifications, and NFPA 90A and 90B shall be incorporated into all heating, cooling, and ventilating systems. Corridors shall not be used as return, supply, or exhaust plenums in any type of occupancy. Corridors in existing facilities where installation of return ductwork is not physically feasible may be used as return plenums. When the designer proposes to use corridors as return plenums, the design analysis will clearly indicate that return ductwork installation is not physically feasible.

11.8.5.2 Contract drawings for new sprinkler systems shall indicate the exposure classification for all areas and all the design factors required (See MIL-HDBK-1008C) for the contractor to hydraulically calculate the system design. Designer is responsible for determining the adequacy of the existing water supply and the provision for a fire pump if required. System riser and pump piping diagram shall also be shown on the drawings.

11.8.5.3 AFFF Containment and Release: The uncontrolled release of AFFF poses a possible risk to wastewater treatment plants due to its Biological Oxygen Demand (refer to Air Force ETL 86-6). Foam Solution Retention recommends containment for controlled discharge into sewage treatment facilities at a rate of not more than 100 parts per million (ppm) by weight. Containment can be either by use of an aboveground storage tank or lined surface-storage lagoon. Under normal conditions flow out of the containment lagoon should be uncontrolled such that storm water would be allowed to either run off or be pumped out. In the event of an AFFF release an automated valve would ensure total containment of the pond's contents for controlled release. In the event the AFFF solution is mixed with a hazardous material/waste, the entire contents of the lagoon will be a hazardous waste and will be disposed of accordingly. Design retention ponds to be centrally located serving multiple facilities.

11.8.5.3 SPECIAL INSTRUCTIONS FOR AIR FORCE PROJECTS:

MIL-HNBK-1008C has a number of paragraphs which include references to AFR 88-15 which is currently rescinded. The MIL-HDBK-1008C and the applicable Air Force ETLs shall be used for Fire Protection Criteria with the following exceptions:

A. Allowable Floor Area. Use the allowable floor area and allowable area increases in the Uniform Building Code (Current Edition) unless specific guidance is provided in 1008C or Air Force ETLs. The areas may be tripled in all buildings if the entire building is protected with an approved automatic sprinkler system. This increase may be used even when the sprinkler system is installed to:

- a. Increase building height
- b. Permit the construction of an atrium

B. Maximum Height of Building. Use the allowable heights and allowable increases in the Uniform Building Code (Current Edition) unless specific guidance is provided in 1008B or Air Force ETLs.

C. Separation of Structures. The required clearance between structures. The required clearance between structures will be determined in accordance with the Uniform Building Code (Current Edition) unless specific guidance is provided in Air Force ETLs.

11.8.6 Noise control shall be in accordance with TM 5-805-4.

11.8.7 Ductwork Design - Ductwork shall be designed in accordance with ASHRAE recommendations and applicable SMACNA standards. For low velocity ductwork the supply ductwork shall be sized at approximately 0.08"/100' pressure loss and exhaust-return systems shall be sized at approximately 0.05"/100' pressure loss. Variable Volume and High Pressure duct systems shall be sized by static regain method.

11.8.8 Compressed Air System - Unless other more specific requirements are provided in the scope of work, the compressed air system shall be designed from an analysis of the equipment layout and thorough coordination with the Using Service requirements. This includes calculation of peak requirements, compressed air flow, piping losses, storage capacity, and minimum pressure required at utilization points.

11.9 Emergency Engine-Generator Units

11.9.1 General: This feature requires careful coordination between the mechanical and the electrical designer. Specifications and plans covering the fuel system, fuel storage tank, exhaust, cooling system, space ventilation, generator sizing, engine size, electric conductors and service gear, transfer switch, and all other required appurtenances.

11.9.2 Ventilation for Emergency Generator Units - Ventilation shall be sufficient to maintain the room temperature below 120F with a maximum temperature of 125F. The following factors shall be used in calculating the ventilation rate:

- a. Heat given off by generator and exciter - 8 Btu per KW per min.
- b. Heat given off by engine surfaces (either dry or water cooled manifold) - 10 Btu per HP per minute
- c. Heat given off by exhaust system - Initial surface temperature of 750F to 950F for engines with water cooled manifolds.

11.10 Gas Distribution System and Piping: Gas distribution system shall extend from a point of connection with the existing main to a point 5 feet from the building. Gas distribution system plans and specifications are normally handled by the site utility designer. Gas piping connects at the five (5) foot line and covers all interior gas piping. Maximum line pressure for interior gas piping shall be 25 psig. The system shall be designed such

that there will be no exposed gas lines or meters in front of the facility. All interior gas piping shall be concealed except for appliance connectors and in the mechanical room.

11.11 Heat Pumps: Heat pumps may be used for locations where the winter design temperature is 12F or above after a Life Cycle Cost Analysis has shown heat pumps to have the lowest life cycle cost. Heat pumps shall be in accordance with the requirements of the guide specifications and shall be certified under the Heat Pump Program of the ARI. Minimum Heating Seasonal Performance Factor (HSPF) and Seasonal Energy Efficiency Ratio (SEER) ratings for air-to-air heat pumps shall be as follows:

<u>ARI Cooling Capacity</u>	<u>SEER</u>	<u>HSPF</u>
Up to 19,000 BTUH	12.0	7.0
19,000 to 135,000 BTUH	12.0	7.0

11.12 Heating Plants Specific Criteria

11.12.1 Fuel Source Selection

a. The design of all large boiler heating and power plants should be based on the use of coal or the future convertibility of the plant to coal.

(1) Particulate collectors necessary to meet air pollution abatement regulations shall be installed at the time of construction. Adequate consideration shall also be given in the design to provide for the future addition of sulfur removal equipment in the event that high sulfur coal supply becomes economically attractive in the future. A coal convertible design utilizes boilers increased in size to accommodate future coal combustion but are arranged to burn oil and/or natural gas, and space is provided for future particulate collectors, flue gas sulfur removal equipment, and solid fuel and ash handling and storage facilities. Close attention to environmental regulations and air pollution control equipment availability will be required. The Defense Fuel Supply Center should confirm coal availability before the design of a coal burning plant is started.

(2) Replacement boilers or additional boilers for existing plants will continue to burn the present fuel.

b. For plants of 20 MEGA BTUH or less input, fuel oil or natural gas will be selected on the basis of a Life Cycle Cost Analysis.

(1) All new fuel oil fired plants, from 5 to 20 MEGA BTUH input, will be capable of burning all grades of fuel oil, No 2 through No. 5. Above 20 MEGA BTUH, new plants will be capable of burning all grades of fuel oil No. 2 through No.6. This requirement does not apply where oil is the alternate fuel in a dual fuel plant. In this case, the alternate fuel should be selected on the basis of life cycle costs and availability.

(2) Replacement boilers or additional boilers in existing plants must be capable of burning the same range of fuel as the existing boilers.

(3) Gas-fired plants require reasonable assurance be obtained from the utility company as to the availability of natural gas. The design analysis shall include copies of telephone logs indicating coordination with the utility company.

(4) Fuel oil standby capability will be provided for all gas fired plants where life cycle costs of interruptible versus firm gas commitments can justify the additional costs associated with liquid fuel handling facilities.

(5) Plant size should be based on installation projections for 5 years beyond project design date.

11.12.2 Heating Plants with Multiple Boilers:

- a. Plants shall be designed to be expanded when the five (5) year installation projections indicate significant future loads.
- b. Standby boilers or additional boilers for future loads shall not be installed initially.
- c. The number and size of the boilers selected shall efficiently handle the maximum winter design load and the minimum summer load. With one boiler off-line, the remaining boiler(s) shall be capable of carrying not less than 65% or more than 75% of the winter maximum design load. Any exceptions to this policy must be submitted, with a thorough supporting engineering analysis, to the Norfolk District for approval.

11.12.3 Fuel Storage: All plants will be provided with sufficient storage capacity for a minimum 30 day supply of liquid fuel and 90 days supply of coal, based on the maximum continuous expected demand.

4.11.12.4 Dual Fuel Capability: All major oil or natural gas plants shall be installed with dual fuel capability where economically feasible.

11.13 Ventilation for Equipment Rooms

11.13.1 Refrigerant Compressor Rooms for Walk-in and Reach-in Refrigerators: Air-cooled condensing units with integral condensers will be provided with not less than 800 cfm of air per horsepower (nameplate rating). Water-cooled condensers and remote air-cooled condensers will be provided with not less than 80 cfm of air per horsepower (nameplate rating). Compressor rooms shall be provided with outside air intake louvers and thermostatically controlled exhaust fans.

11.13.2 Mechanical equipment and laundry (laundromat) rooms will be provided with outside air intake louvers and a thermostatically controlled supply fan. The fan will have a two-speed fan motor and will provide not less than 20 air changes per hour during summer operation and not less than 10 air changes per hour during winter operation.

11.14 Electric Resistance Heat: Electric resistance heat for personnel comfort is normally prohibited except:

- (1) Where used as supplemental heat in a heat pump system
- (2) Where the total facility load is less than 15,000 BTUH, and resistance heating is the most economical option on a life cycle cost basis.
- (3) Where a life cycle cost analysis indicates it is cost effective and written approval is received from the Norfolk District.

11.15 Gas-Fired Furnaces: NFPA-54 and the following guidance shall be used:

- a. All return air will be ducted to furnaces. The furnace room shall not be utilized as a return air plenum.

11.16 Mechanical Equipment Spaces: Mechanical equipment (sized from three manufacturers), piping, ductwork, and accessories in boiler and equipment rooms shall be drawn to scale on the drawings in both plan and elevation. Adequate space shall be provided for maintenance, operation, and replacement of equipment, piping, ductwork, and accessories. Catwalks, ladders, platforms, access panels, and doors required for

operation and maintenance of equipment, valves, and accessories shall also be indicated and detailed on the drawings.

11.17 Plumbing

11.17.1 Plumbing design shall conform to the requirements of the National Standard Plumbing Code (NAPHCC). Fixture number determinations shall be made in accordance with the criteria contained in the AEI.

11.17.2 Wall hydrants shall be located on all sides of facilities and shall have a maximum spacing around the perimeter of 200 feet. Add 5 gpm for each hose bibb or hydrant to the building load for sizing the water main.

11.17.3 Kitchen Wastes: Kitchen waste drains from equipment likely to generate grease laden waste discharge shall be drained through a grease interceptor. Interceptor shall be sized for a minimum operation of 30 days without cleaning.

11.17.4 Roof Drainage: Gutters and exterior downspouts will be sized by architectural design elements, shown on the architectural drawings, and specified in the architectural sections of the specifications. Roof drains and interior drain piping, including collection system, shall be sized by the plumbing designer, shown on the plumbing plans, and specified in the plumbing section of the specifications.

11.17.5 Design for the Physically Handicapped: Appropriate modifications to plumbing fixtures shall be included in all projects designated to be suitable for access by the physically handicapped. Design shall comply with the "Uniform Federal Accessibility Standards (UFAC); Fed Std 795. The Americans With Disabilities Act (ADA), of 1990 does not apply to Federal Projects.

11.17.6 Domestic Hot Water:

- a. Domestic hot water supply temperatures shall be as indicated below unless higher temperatures are required by site specific requirements.

Facility or Area	Max. Temperature
Administrative, Theaters, Maintenance Facilities, Bowling Alleys, Educational, Post Offices, Libraries, etc.	110 degrees F
Barracks and BOQ, Chapels, Exchange Facilities, Fire Stations, and Guard Houses	110 degrees F
Post Laundries	160 degrees F (or as required by type of fabric)
Dining Facilities, General Use	140 degrees F
Dining Facilities, Sanitizing	180 degrees F
Family Housing	120 degrees F
Service Club, Cafeteria, Officers' and NCO Clubs	140 degrees F
Swimming Pool, Gymnasium, and Field House	115 degrees F

Commissary

140 degrees F

- b. A water heating system using a three-way mixing valve may be used where equipment room space is limited and/or the water heater is designed to supply hot water at temperatures greater than required by all fixtures.
- c. Domestic hot water requirements for medical facilities will be as specified in TM 5-838-2.
- d. Domestic water heater sizing shall be in accordance to with the requirements of TM 5-810-5.

Where the facility type under design does not exactly match a category in the TM, the ASHRAE recommendations will be used as applicable.

11.17.7 Connection of Potable Water Supply with Utility Systems Having Chemical Treatment Facilities: When a potable water supply is connected with a utility system such as heating systems, chilled water systems, or cooling towers, which is equipped with chemical treatment facilities, a reduced pressure/double check valve type backflow-prevention device shall be provided.

11.18 Liquid Fuel Storage, Distribution, and Dispensing

11.18.1 Design in accordance with current EPA guidelines and the following information:

- a. All buried fuel oil storage tanks shall be of double-walled construction. Double-wall shall provide for an annular space and 360 degree containment.
- b. All buried fuel oil lines shall be contained in a carrier pipe to provide for spill containment. See specifications section 13202.
- c. All buried storage tanks and piping shall be protected by an automatic electronic leak detection system. Leak detection system shall not utilize sniffers or vacuum for leak detection.
- d. Aboveground secondarily contained fuel tanks may also be used with the approval of the Facility DPW.
- e. For Air Force projects all fuel systems and equipment shall be designed in accordance with Air Force DM-22.
- f. Air Combat Command (ACC) policy is to avoid installing underground POL storage tanks. Prior approval, in writing, must be obtained from ACC prior to the design of any underground storage tanks. Existing underground storage tanks should be replaced with above ground tanks where feasible.

11.19 Seismic Protection for Mechanical Equipment: All projects for new facilities and major rehabilitations shall include appropriate provision for protection of mechanical piping, equipment, and underground utilities against damage from seismic events.

11.20 TEMPEST/EMP/RFI Shielding

When identified in the scope of work, shielding requirements shall be included as features in the mechanical/plumbing/sprinkler design. For Air Force Projects, the requirements for TEMPEST applications will be validated by the base TEMPEST Officer prior to design start. Designer shall refer to Air Force ETL 90-3 for additional information. The designer must identify shielding costs separately in the cost estimate and bid schedule.

11.21 Utility Meters

Utility meters for water, fuel oil, and natural gas are required for all new and renovated facilities. For Air Force projects refer to ETL 87-5 for additional information.

11.22 CFC Limitations

Current Corps of Engineers policy limits the choice of refrigerants to those which have an Ozone Depletion Potential of 0.05 or less, this typically means R-22, R-123, or R-134a are required for use. For Air Force projects similar guidance exists as contained in Air Force ETL 91-7.

11.23 Norfolk District Design Special Instructions:

11.23.1 Hot water and steam boilers shall not be of the single pass, straight or inclined tube design. Bent Tube watertube boilers are acceptable.

11.23.2 Kitchen range exhaust hoods may utilize supply air type hoods provided the hood is constructed with the ability to discharge the supply air into the kitchen in summer. Make-up air shall be tempered.

11.23.3 Mechanical equipment rooms must be provided with positive ventilation.

11.23.4 All VAV Boxes on VAV systems shall be provided with HOT WATER HEATING Coils to provide for heating capacity of the supply air stream. Size coils to provide a minimum leaving air temperature of 85F to 90F.

Norfolk District
Certificate for Design
of

MECHANICAL EQUIPMENT ROOMS

BASE: _____ FY - _____ PROJECT NO. _____

PROJECT: _____

ARCHITECTURAL DESIGN FIRM NAME: _____

MECHANICAL DESIGN FIRM NAME: _____

I certify that the mechanical room has sufficient space to accommodate, and service all mechanical equipment as shown on the mechanical and plumbing drawings. Further, I certify that the mechanical equipment locations and requirements do not conflict with the requirements/locations of electrical equipment located in the space.

Signature of Architect DATE: _____

Signature of Mechanical Engineer DATE: _____

Signature of District Reviewer (Mec) DATE: _____

General Checklist for Energy Analysis
Energy Budgets and Life Cycle Cost Analyses

Project Title/Number: _____

Site: _____

Designer: _____

Checker: _____

Date: _____

PRECONCEPT PHASE:

(When Applicable)

_____ Is an acceptable energy modeling method being utilized?

_____ If a previous design is being site adapted, have the analyses been verified as acceptable or updated for the current project? Is the information presented complete and clear?

_____ Is this a major renovation project? If so, have the necessary studies been completed?

_____ Have HVAC system alternatives been discussed with Norfolk District Mechanical Section?
(Optional)

_____ Have complete input and output information been included?

_____ Is the Energy Budget below the required Energy Target?

_____ Has a narrative been presented to explain the results?

CONCEPT DESIGN PHASE:

_____ Are U-Value calculations and optimizations complete? Are U-Values in accordance with AEI requirements?

_____ Are Energy Budget calculations complete?

_____ Are Active Solar calculations complete?

_____ Are Passive Solar calculations complete?

_____ Have approvals been received for any Active or Unique Passive Solar applications been provided?

_____ Have all energy modeling input/output data been submitted?

_____ Have all analyses been checked for completeness and math errors?

- _____ Have the outline specifications been included?
- _____ Has the EMCS requirements been investigated and addressed?
- _____ Have all required studies been completed and submitted?
- _____ Are the names and credentials of all design professionals included?

FINAL DESIGN PHASE:

- _____ Have any significant changes occurred since the Concept? If yes, then have all applicable analyses been completed and included?
- _____ Have all technical comments been resolved and satisfied?
- _____ Have any Value Engineering Proposals been incorporated into the design?
- _____ Are U-Values listed on the drawings in accordance with the design analysis requirements?
- _____ Are Controls plans and specifications complete, checked and ready for submission?
- _____ Are EMCS plans and specifications complete, checked and ready for submission?
- _____ Is the Final Design Analysis complete, checked and ready to submit?
- _____ Have all required submittal items been included?

Exhibit -2
----END OF CHAPTER---

CHAPTER 15

ENERGY ANALYSES, ECONOMIC ANALYSIS, CONTROL SYSTEMS, EMCS

1.0 GENERAL: It is the policy of the United States, the Federal Government, and the US Army Corps of Engineers to develop, promote, and utilize energy conservation methods in Federal Buildings.

1.1 Coordination: The requirements of this chapter dictate involvement and work by various disciplines. All work shall be thoroughly coordinated. (Submittals shall be contained in one consolidated document, except for computer input/output data which may be bound separately.)

1.2 Qualifications: Supervision of work required by this chapter must be performed by a Registered Professional Engineer with experience in HVAC systems and associated fields.

1.3 Analyses: Designers shall submit the required work in accordance with the approved project schedules. Terminology, acronyms, abbreviations, and symbology shall be defined. All calculations, data, methods, assumptions, and conclusions shall be documented.

1.3.1 Methods: Technical analyses shall be performed using acceptable industry practices and ASHRAE recommendations. Judgement, experience, rule-of-thumb, and other non-quantitative methods shall not be allowed in lieu of the required analyses.

1.4 LCCA Studies and Energy Budgets: Energy Budget calculations and Life Cycle Cost System Selection Studies shall be included in the submittal indicated.

1.4.1 Rules: The substantial consideration in the selection of alternatives to investigate in LCCA studies shall be the mission of the user. Alternatives investigated must meet the functional requirements. Selections between alternatives shall be made based on lowest total life cycle cost and a resulting Energy Budget estimation which is equal to or less than the required Energy Target as listed the current version of the AEI, Chapter 11. If alternatives have equivalent lowest life cycle costs (within 5%), the procedures contained in TM 5-802-1 shall be used to determine the alternative to be selected.

1.5 Site Adaptations/Standard Designs: Requirements given in this chapter apply equally to new designs, major renovations, standard designs, and adaptations of previous designs. Any exceptions to these requirements must be specifically reflected in the project scope of work in writing.

1.5.1 Modifications: Designers will be required to modify previous designs in order to meet energy usage goals, incorporate conservation methods, and bring the design into conformance with current criteria.

1.5.2 Analyses: All pertinent analyses must be submitted for adaptations unless specific exclusion from this requirement is included in the project scope of work. Use of previous economic analyses will only be allowed when the significant economic factors (e.g fuel cost, first costs, UPW factors) are unchanged. Previous design analyses for HVAC systems selections may be reused provided the following conditions are met:

- a. The designer shall review and verify the previous analysis
- b. Climate, siting, and orientation must be equivalent
- c. Design factors impacting design must be equivalent
- d. Alternatives being studied must be equivalent
- e. Previous analysis methods must meet current requirements

1.6 Changes During Design: All significant changes and their impacts shall be documented in revised and resubmitted analyses, regardless of when or how the change occurs in the project. Significant changes would

include anything changing the life cycle cost analysis or energy budget estimations by more than +5% or which result in a facility non-compliance with the required energy target.

2.0 APPLICABLE PUBLICATIONS: See AEI for applicable publications.

3.0 CONCEPT SUBMITTAL REQUIREMENTS: Unless otherwise stated, the following items shall be submitted at, or prior to, the concept design submittal.

3.1 HVAC Alternatives Analysis: Designer shall select at least three applicable HVAC systems which will support the function of the building. Unusual or special alternatives should be discussed with the District Design Branch, Mechanical/Electrical Section Chief prior to proceeding with the analysis. Designer shall include date of discussion, person contacted, and basis of understanding reached, in the submittal.

3.2 Solar Applications: Active solar analyses are required only when specifically indicated in the project scope or design instructions. Unless otherwise indicated, passive solar analyses shall be limited to implication of normal passive solar applications as explained later. Designer should routinely investigate and address solar loadings and associated items.

3.3 Submittal Contents: As applicable, the following items shall be included in the concept design submission:

- a. Copies of the Input/Output data for Life Cycle Cost Analyses (LCCA)
- b. Copies of the Input/Output data for Energy Budget Calculation
- c. Single line drawings showing zoning of the facility
- d. Narrative of Target Energy Budget and a list of all criteria used
- e. Narrative of LCCA options examined
- f. For Air Force Projects, Energy Budget submission shall be made in accordance with the format as shown in Exhibit -1 and in strict accordance with Air Force ETLs.
- g. U-Value optimization calculations for exterior surfaces
- h. Solar analyses (when applicable)
- i. Previous HVAC systems selection studies (when applicable)
- j. Previous Energy Budget calculation (when applicable)
- k. Executive summary of results of LCCA and EB

4.0 SIXTY PERCENT (60%) SUBMITTAL REQUIREMENTS

4.1 General: No formal submission requirements for Life Cycle Cost Analyses or Energy Budget calculations exist at this submittal stage. If the project scope of work has been modified or a new alternative is proposed than the requirements as listed for Concept Submittal shall be followed.

5.0 FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS

5.1 General: No formal submission requirements for Life Cycle Cost Analyses or Energy Budget calculations exist at this submittal stage. If the project scope of work has been modified or a new alternative is proposed than the requirements as listed for Concept Submittal shall be followed.

6.0 CORRECTED FINAL DESIGN SUBMITTAL (BACKCHECK) REQUIREMENTS

6.1 General: There are no submission requirements for Energy Budgets or Life Cycle Cost Analyses at this stage.

7.0 SECOND FINAL (SECOND BACKCHECK) SUBMITTAL REQUIREMENTS

7.1 General: Second final submittals are not a normal design review level. They are required only due to poor performance of the Designer or the corrections required which were not made at Backcheck Submittal.

8.0 TECHNICAL REQUIREMENTS

8.1 General: This section prescribes the detailed procedure, acceptable methods, and minimum content requirements for studies, analyses, and designs. Submittal schedules and special requirements shall be given in the project scope of work. Unless otherwise specified, all applicable studies shall be required for all new building design projects, major additions to existing buildings, and major renovations of existing buildings or energy systems. Engineer shall verify the capability of an installation to operate and maintain a specific system before considering it as a viable alternative. Avoid considering alternatives in Life Cycle Cost Analyses that are clearly impractical due to physical limitations, past design/construction experience, or other predominant circumstances.

8.2 Economic Analysis: Unless otherwise authorized, in writing, constant dollar methods given in TM 5-802-1 and NBS Handbook 135 shall be used. Analyses shall be based on actual expected operating conditions, energy consumptions, and costs. Selections of major systems and equipment must be supported by a new economic analyses except in the following situations. Major systems include all HVAC systems.

- a. Use of a previous study at the same installation if the conditions have not changed.
- b. Use of an existing study from another installation with similar conditions.
- c. Apply the results of a previous study to justify an alternative if using new data will not materially affect the conclusions of the study.
- d. Update an existing study by revising the old data rather than starting a new study from scratch.

8.2.1 Cost Estimates: Economic analyses must include cost estimates. Estimates may be manual or computer generated.

8.2.2 Manual Analyses: When manual analyses are performed they shall be made and submitted on DA Forms 5605-1-R through 5605-5-R as shown in TM 5-802-1 or similar locally generated forms. All manual calculations will be checked/verified using the current edition of the LCCID computer program.

8.2.3 Computerized Analyses: Computerized analyses shall be made using the DOS PC program LCCID (Life Cycle Cost in Design) available from the BLAST Support Office (1-800-UI-BLAST). Computer programs other than LCCID may be used, however, Designers are reminded that the program used must use the most current discount factors published in the periodic supplement to NBS Handbook 135 and be in accordance with the methodology required.

8.2.4 Site Energy Costs: When purchased energy is used, analyses shall be based on site energy usage and the actual cost of energy at the site. Purchased energy is energy for which the site is billed at a rate which includes all applicable costs (e.g. fuel costs, operating costs, generating losses, distribution losses, etc).

8.2.5 Source Energy Costs: When generated energy is used, analyses should be based on the systems source fuel input, fuel costs, and efficiencies. Generated energy is energy for which the Government operates the generation and distribution systems.

8.2.6 U-Values: Exterior surfaces of thermally controlled spaces shall have U-Values minimally set at the levels as prescribed in the AEI, Chapter 11. Further optimization of the U-Value levels shall be accomplished as necessary to comply with the Energy Budget requirements.

8.3 Energy Budget (EB) Calculation: An Energy Budget calculation shall be submitted for each new building and each building with a major renovation involving energy systems and/or exterior surfaces. Energy Budget calculations shall be based on all loads except process loads. Hours of operation and additional information are contained in the AEI, Chapter 11. Designer shall become very familiar with the requirements of Chapter 11 of the AEI prior to completing the Energy Budget calculation procedure.

8.3.1 Energy Budget Targets (EBT): The Energy Targets are listed in Chapter 11 of the AEI. These levels are absolute maximums.

8.3.2 Availability: Energy Budget shall be based on 100% availability of energy systems during occupied hours and 0% availability at all other times. Availability does not reflect usage or setpoints.

8.3.3 Conversion Factors: Energy use or savings shall be calculated using the following factors:

ENERGY MEDIUM	CONVERSION FACTOR
Electricity - Purchased	3,413.00 Btu/kWh
Electricity - Generated	11,600 source Btu/site kWh
Steam - Purchased	1,000 Btu/lb
Steam - Generated	1,390 source Btu/site lb
Natural Gas	1,030 Btu/cf
LPG, Propane, Butane	4,011,000 Btu/barrel
Oil - Distillate	5,825,400 Btu/barrel
Oil - Residual	6,287,000 Btu/barrel
Coal - Bituminous	24,500,000 Btu/2,000 lb
Coal - Anthracite	28,300,000 Btu/2,000 lb
Water - other than steam	Use energy value at site boundary
Biomass or Refuse	Use site data and lab analysis
1 cf = 28.32 liters	1 barrel = 42 US gallons
1 kg = 2.0246 lb	1 Btu/(h-sf-F) = 5.678 W/(m-m-C)
1 m = 3.2808 ft	1 (Btu/sf)/yr = 3.154 (Wh/m-m)/yr
1 kWh = 3,600 kJ	1 Btu = 1.055 kJ
1 hp = 0.7547 kW	

8.3.4 Site/Source Energy: Energy Budget shall be based on site energy usage, except as indicated below. Site energy usage is defined as usage occurring within an imaginary five foot boundary line around the building.

- a. Energy crossing the boundary shall be measured or accounted for at the boundary with proper credit given for usable returned energy (steam, chilled water, high temperature water, etc).
- b. When equipment or systems located outside the five foot line and serve one building, their energy usage shall be included in the Energy Budget. When equipment or systems are located outside the five foot line and serve five or less buildings, their energy usage shall be prorated among the buildings they serve.

8.3.5 Gross Area: Energy Budget analysis shall be based on the building gross area. Gross area is defined as the sum of all floor areas including basements, cellars, mezzanines, other intermediate floors tiers, and penthouses. All measurements shall be taken from the outside of the exterior walls and from the center line of party walls.

8.3.6 Domestic Hot Water Usage: For Energy Budgets, domestic hot water usage may be estimated as follows:

$$Q = N * A * D * (T1 - T2) * 8.33$$

Q = HW energy usage in Btu

D = Days of HW consumption

N = Number of people served daily

T1 = Outlet Water Temp (F)

A = Gallons per person (TM 5-810-5)

T2 = Inlet Water Temp (F)

8.3.7 Process Energy: The items listed below are considered process. HVAC required in direct support of a process is considered part of the process. Interior lighting is not considered a process load.

- a. All non-real property
- b. Installed equipment (e.g. refrigerated cases, etc)

- c. User equipment (computers, copiers, typewriters, etc)
- d. Industrial equipment
- e. Training systems
- f. Hot water for gyms, cafeterias, and commissaries
- g. Specialized ventilation as required by OSHA
- h. Exterior perimeter lighting

8.4 Solar Energy: Solar applications are categorized as active, passive, or direct conversion. Solar applications are items, components, equipment, or systems used to collect, store, or apply the sun's radiant energy. Normal applications are considered within the projects authorized funding. Unique applications are beyond the project scope of work or funds available and will require additional funding.

8.4.1 Active Solar: When non-solar energy input is required for routine function of solar application, that application is defined as active solar.

8.4.1.1 Application: Active solar applications need only be considered for projects when they are specifically identified in the project scope.

8.4.1.2 Analysis Methods: Active solar analyses for Army projects shall be performed using one of the following computer programs or a program pre-approved by Norfolk District Mechanical/Electrical Section.

- a. Detailed Thermodynamic simulation (per ASHRAE)

For Air Force projects, LCCA's shall be performed using Air Force ETL 89-1 requirements and shall consider the difference in LCC for the alternative under consideration and the optimum (most economical) alternative.

8.4.2 Passive Solar: In contrast to active solar, passive solar applications do not require nonsolar energy input for routine operation.

8.4.2.1 Application: Normal passive solar applications must be considered for new building designs and major renovation projects. Unique applications need only be considered when specifically called for in the project scope of work.

- a. Normal Applications: The following are examples of normal passive solar applications:

1. Interior Space Layout and Zoning
2. Landscaping (e.g. shade trees, shrub buffers)
3. Berming or below grade construction
4. Building shape and surface area ratios
5. Siting (e.g. wind effects, existing shading)
6. Building orientation and spacing from other facilities
7. Constructed shade (e.g. overhang, recessed window, etc)
8. Natural lighting and space heating
9. Surface properties (e.g. reflectivity, absorptivity)
10. Daylighting light controls

- b. Unique Applications: The following are examples of unique passive solar applications:

1. Attached sunspaces
2. Thermal storage walls
3. Induced stacks
4. Solar chimney
5. Phase change thermal storage
6. Roof pond systems
7. Thermosiphon collector (convective loop)
8. Atriums for inner perimeter lighting

- 9. Extensive window areas for natural lighting
- 10. Clerestories for space heating and natural lighting
- 11. Extensive skylights for space heating and natural lighting

8.4.2.2 Analysis Methods: For Army Projects the designer may utilize any computer analysis method recognized by ASHRAE to determine the feasibility of the applications of unique passive solar features.

For Air Force projects, LCCA's shall be performed using Air Force ETL 89-1 requirements and shall consider the difference in LCC for the alternative under consideration and the optimum (most economical) alternative.

8.4.3 Direct Conversion Solar: Specific instructions for inclusion of direct conversion methods will be included in the project scope and/or design instructions. Direct conversion methods shall not be included in a project unless specifically identified in the project scope.

8.5 Energy Conservation: It is the policy of the Federal Government to develop and promote the use of energy conservation methods in public buildings. Towards that goal, designers shall evaluate and select conservation methods applicable to federal buildings. Technically and economically justified methods shall be included in designs.

8.5.1 General Energy Conservation Methods: Listed below are general examples of conservation methods. This list is not intended to be all inclusive nor is it intended to limit creativity. Energy conservation methods should be included in all design projects.

- a. Energy recovery
- b. High power factor motors
- c. Loading dock seals
- d. Evaporative cooling
- e. Air destratification
- f. Selective task lighting
- h. High efficiency lighting
- i. Zone controlled lighting
- j. High distribution voltage
- k. Minimal heating of stairwells
- l. Buffer spaces next to exterior walls
- m. Point of use, on demand water heaters
- n. Convenient stairs to minimize elevator usage
- o. Automatic controls (e.g. times, scheduling)
- p. Vestibules or air locks at entrances
- q. Natural ventilation (e.g. operable windows, vented roof)
- r. Landscaping to reduce convection losses during heating season
- s. Optimized thermal envelopes

8.5.2 Special Energy Applications: 'Special Applications' of energy conservation methods are only required when specifically identified in the project scope or designer instructions. Analyses shall use recognized engineering methods as given in the ASHRAE Handbooks or other methods specifically approved by the Norfolk District. Some examples are listed below:

- a. Fuel cells
- b. Wind energy systems
- c. Geothermal energy systems
- d. Well water cooling systems
- e. On-site power generation

8.5.3 Nonsolar Energy Systems: A minimum of three alternatives shall be studied.

8.5.3.1 HVAC Systems. Studies of HVAC system alternatives is required for all new projects and major rehabilitations. Alternatives shall be selected from the table below or coordinated with the Norfolk District Mechanical/Electrical Section prior to initiation of the analyses. Equipment life estimations shall be taken from ASHRAE data with the exception that air source heat pumps shall be considered to have a useful life of 7 years for the compressor.

RECOMMENDED HVAC ALTERNATIVE SYSTEMS:

- a. Variable Air Volume - Fan Powered Boxes
- b. Variable Air Volume - Series
- c. Variable Air Volume - Parallel
- d. Single Zone Air Handling Units
- e. DX Cooling
- f. Chilled Water Cooling
- h. Gas-Fired Furnace
- i. Oil-Fired Furnace
- j. Gas-Fired Boiler
- k. Oil-Fired Boiler
- l. Fan Coil Units
- m. Infrared Heaters
- n. Fin Tube Radiation
- o. Heat Pump
- p. Hydro-Heat System
- q. Air Cooled Chiller
- r. Water Cooled Chiller
- s. Packaged Rooftop Units
- t. Packaged Computer Room Units

8.5.3.2 HVAC System Analysis: System analysis shall use appropriate methods as indicated in the current ASHRAE Fundamentals Handbook. All energy estimating shall be estimated using computer based analysis tools. Energy Analysis shall be an hourly based computer program such as BLAST or DOE 2.1.

8.5.4 Existing HVAC Systems Study: For any major HVAC replacement or renovation project, an engineering analysis of functional or reasonably repairable existing HVAC systems is required. As a minimum, the study shall consist of the work stated herein. Major projects are defined as meeting any one of the following criteria:

- a. Scope/Instructions state that major HVAC renovation/replacement is involved.
- b. HVAC renovation or replacement exceeds \$500,000
- c. Annual O&M cost of existing HVAC exceeds \$20,000

8.5.4.1 Data: Sufficient data shall be included in the report Study to substantiate all conclusions and recommendations as well as copies of all field survey notes and/or information.

8.5.4.2 Analysis and Report: Engineering analyses shall be conducted based on data gathered during the study. A report shall be submitted which includes data collected, analyses made and a narrative discussion of the results. As a minimum, the following items shall be included in the report:

- a. Heating and cooling load profiles
- b. Calculated annual energy usage of the existing facilities
- c. Energy usage by components (lights, heating, cooling, etc)
- d. Comparison of installed capacities with calculated loads
- e. Options for improving systems (balancing, schedules, etc)
- f. Economic evaluation of alternatives with recommendations

8.5.4.3 Unobtainable Data: If, for acceptable reasons, data needed for a study is not obtainable, then the Engineer shall use good judgement to estimate the missing data. Copies of phone call logs or correspondence attempting to obtain the data shall be provided.

8.5.5 Existing Facility Conservation Study: For major projects involving renovation or retrofit of air conditioned or heated buildings, a thorough engineering analysis shall be made of energy usage and loss factors. Major projects include work meeting either of the following:

- a. Scope/Instruction state the work is a major renovation or retrofit
- b. The total renovation CWE exceeds \$500,000

8.5.5.1 Scope: Evaluate the feasibility and economics of the items listed below, as a minimum. Design of energy systems shall not proceed until this study has been completed and items found to be feasible and cost effective are accomplished, scheduled for implementation or incorporated in the design.

- a. Optimizing U-Values for thermal envelopes
- b. Applicable conservation measures mentioned earlier
- c. Applicable normal solar applications mentioned earlier
- d. Energy saving methods obvious to the Engineer making the study

8.5.5.2 Analysis and Report: Engineering and economic analyses shall be performed for the pertinent item listed above. A report shall be prepared and submitted which includes field data, analyses, and a narrative discussion of the results. The following items, as a minimum, shall be included in the report:

- a. Energy usage breakdown (heating, AC, lighting, etc)
- b. Existing construction U-Values and infiltration
- c. Listing of alternatives and measures studied
- d. Energy usage impact of items studied
- e. Economic impact of items studied

8.5.6 Energy Conservation Investment Program (ECIP): Projects shall be accomplished in accordance with ECIP guidance.

8.5.7 Energy Engineering Analysis Program (EEAP): Scope of work requirements shall be provided on a case by case basis.

8.6 HVAC CONTROLS:

8.6.1 General: Designs for HVAC Control Systems shall be electric or electronic controls, including DDC (Direct Digital Controls) except for DGSC which does not have a DDC based EMCS. Pneumatic actuators are acceptable but pneumatic controls are not allowed. Controls shall be based on Single Loop Digital Controls (SLDC) as indicated in TM 5-815-3 or CEGS 15951 unless specifically indicated otherwise.

8.6.2 Drawings: Savannah District has prepared detailed SLDC and DDC control drawings for air conditioning systems which may be used as the basis for controls design. These drawings shall be verified by the designer and corrected where necessary and modified to suit site conditions. These drawings are available in CADD formats in either Intergraph or AutoCAD. Norfolk District has some of the drawings available and the other drawings can be obtained from Savannah as required. Detail designs shall be provided for any system not available from Savannah or Norfolk. The HVAC control plates include the following:

- a. Schematics
- b. Ladder diagrams
- c. List of Components
- d. Control panel details

8.6.3 Specifications: Designer shall edit and add to CEGS specification section 15950 or 15951 as required for the project.

8.6.4 Control Panel Locations: Designer shall reserve and identify clear wall and floor space for each HVAC control panel.

8.6.5 Specific Criteria for Ft Lee and Ft Monroe:

8.6.5.1 A-E prepared plans and specifications shall include all sensors, transmitters, accessories, meters, wiring, and other items required for a complete installation exclusive of the actual DDC panels and required software. Plans and specifications shall indicate that the "Government" shall provide the specific DDC panels configured as required and including all required software, the construction contractor shall be responsible for installation, configuration, and testing of the complete control system after installation.

8.6.5.2 A-E shall provide a detailed list and cost estimate for the DDC panels and software required. This estimate shall be provided to the Norfolk District and the Post DPW not later than the final submittal.

8.7 Energy Monitoring and Control Systems (EMCS)

8.7.1 Site Without EMCS: Project scope/instructions will indicate when a project shall be designed with provisions for future EMCS connections. Projects for which future connection of an EMCS is required shall include:

- a. All provisions for future EMCS shall be so marked on the plans
- b. Utilize EMCS Preparation Guide Specification CEGS
- c. Indicate future EMCS panel and Data Terminal Cabinet (DTC) locations on the plans
- d. Gas Meters - Provide gas meters which can be adapted to an EMCS by addition of a pulsing device.
- e. Electric Meters - Provide meter which can be adapted to an EMCS by addition of a pulsing device.

8.7.2 Sites With An Operational EMCS: Current EMCS systems operational are as follows:

- a. Fort Lee - Honeywell DDC
- b. Fort Eustis - Johnson Controls (Metasys)
- c. Fort Monroe - MCC Powers
- d. Langley Air Force Base - Robersshaw DDC

8.7.2.1 Drawings: Drawings shall include the following:

- a. I/O Summaries (address points) and hardware
- b. Data Terminal Cabinet (DTC)
- c. Space allocation adjacent to DTC for EMCS Panel
- d. 120-volt duplex receptacle adjacent to EMCS Panel
- e. Electric Meters
- f. Gas Meters
- g. Sensors with wells, wiring, conduit, etc, to EMCS
- h. Controls with wiring, conduit, etc, to EMCS
- i. EMCS data transmission media

8.7.2.2 Specifications: Designer shall utilize CEGS Guide Specifications, 1300 series as the basis. Designer shall coordinate with the EMCS vendor for the equipment in place to assure compatibility with the existing system requirements.

8.7.2.3 Failure Logic: Design controls such that in an EMCS failure local loop controls will continue to function or fail to the desired mode of operation.

8.7.3 Waivers: All controls and EMCS designs for Langley Air Force Base shall utilize Robertshaw DDC controls methodology. For all other facilities where DDC systems are utilized, the construction contract shall include all components and wiring up to, but not including the DDC panel itself. The DDC panel shall be a Government Furnished/Contractor Installed piece of equipment provided for the DPW.

----END OF CHAPTER---

CHAPTER 16

ASBESTOS IDENTIFICATION AND REMOVAL

1.0 GENERAL.

1.1.1 Scope. This appendix identifies A-E responsibility for determining the existence of asbestos and implementing the safeguards for its removal. Whenever asbestos containing material (ACM) or presumed asbestos containing material (PACM) is reported by the Installation's DPW/BCE or is discovered by the A-E during a field visit, incorporate the provisions of this appendix into the design documents. Presumed ACM is defined as thermal system insulation and surfacing material found in buildings constructed no later than 1980. Vinyl and asphalt flooring materials in buildings constructed no later than 1980 shall also be considered to be ACM unless verified otherwise. Unless the using agency can provide accurate locations and quantities of asbestos with the DD Form 1391, other programming documents, or supplemental data at the Pre-design Conference, the A-E is responsible for determining the actual existence and/or nonexistence of asbestos on all renovation, rehabilitation, or demolition projects. If the A-E firm indicates an inability to determine the existence of asbestos or implement safeguards for its removal due to insurance restrictions, they must immediately inform the PE/A in writing at the submittal of the initial fee proposal. Asbestos survey and abatement may then be accomplished independently by the Norfolk District for incorporation into the construction documents.

1.1.2 Overview. Exposure to airborne asbestos has been associated with four diseases: lung cancer, gastrointestinal cancers, pleural or peritoneal mesothelioma, and asbestosis. The U.S. Environmental Protection Agency and the Occupational Safety and Health Administration have adopted regulations requiring control procedures to prevent emission of asbestos to outside air and to ensure safe working conditions during demolition or renovation of buildings or structures. These procedures apply to any work that involves material which contains asbestos. Examples of materials which may contain or be covered by asbestos are as follows:

- a. piping
- b. ducts
- c. boilers
- d. turbines
- e. furnaces
- f. walls, ceilings, floor tiles, roofing, siding
- g. sprayed on acoustic and/or fireproofing materials
- h. textiles such as gasket rope, curtains, etc.
- i. soil

1.1.3 Architect-Engineer Requirements. The A-E (or their asbestos design consultant) shall have attended an EPA certified asbestos designer training course and successfully passed the course examination. The asbestos designer must also be certified, licensed, or accredited, whichever the case, in the state in which the asbestos abatement/removal action is to take place. Comply with the provisions of this chapter for design purposes where the following conditions indicate asbestos (friable or nonfriable) is to be encountered:

- a. if the site is found to be or suspected of being asbestos contaminated and is to be demolished or renovated,
- b. if the asbestos on-site will be drilled, scraped, sanded, grinded, cut, or abraded thereby releasing asbestos, or
- c. if any on-site asbestos will be enclosed or encapsulated.

1.1.4 Architect-Engineer Responsibilities. Demolition of asbestos materials without State or Environmental Protection Agency (EPA) notification and improper work practices can result in a \$10,000 per day fine being levied on both the building owner and the construction contractor. Guide Specification CEGS-13280, and

Modmaster Section 13281 is written so that the construction contractor will be required to provide the written notifications and report to the State or EPA. It is A-E responsibility to determine existence and location of asbestos material, to prepare contract documents indicating locations and quantities of ACM and recommending methods of disposing of the asbestos hazard, and to prepare an estimate of construction cost relating to the recommended methods.

1.5.1 Site Visit.

1.1.5.1 Investigation. The A-E with professional experience, or their consultant certified in the Comprehensive Practice of Industrial Hygiene (C.I.H.) and having specialized experience in sampling for asbestos and asbestos project design, shall perform a site investigation to determine the existence and location of asbestos material and have bulk samples collected from suspected locations and do any necessary exploratory work on the site, using good engineering judgment.

1.1.5.2 Sampling. In obtaining the samples for testing, follow all OSHA/NIOSH safety requirements for personal and public safety, and insure that the disturbed area will not increase the hazard from release of asbestos fibers. Individuals who have completed EPA Model Accreditation Plan training as Asbestos "Building Inspector" and who hold current accreditation and licensure as such in the State where the inspection work is to be performed shall only collect samples.

1.1.5.3 Analysis. Analyze a sufficient number of samples to cover all suspect materials. Materials contained more than 1 percent asbestos are considered asbestos containing materials (ACM), and this material shall be designated for removal, enclosure, or encapsulation.

1.1.5.4 Notification. Notify the PE/A immediately followed in writing any highly friable, contaminated, occupied areas which pose an immediate threat to health of the occupants.

1.1.5.5 Testing. Send the samples to a state licensed and accredited asbestos analytical laboratory for testing to determine percent of asbestos, and binding material and the results documented with the 60% Design Analysis. Use Polarized Light Microscopy (PLM) analysis for initial screening. Analysis of floor tile and other resinously bound materials by EPA Method 600/M4-82-20, Dec. 1982 may yield false negative results because of method limitations in separating closely bound fibers and in detecting fibers of small length and diameter. Therefore, perform a qualitative assessment of vinyl floor tile and sheeting by the transmission electron microscopy (TEM) method. The quality analysis of vinyl tile and sheeting by TEM shows that asbestos is either present in high portions or not present in detectable quantities. Report floor tile qualitative TEM results as "> 1% asbestos", "< 1% asbestos, trace", or "no asbestos detected". By specifying qualitative analysis only for floor tile and sheeting, considerable cost saving should be realized over the quantitative assessment usually done by the TEM method.

1.1.5.6 Laboratory Qualifications. Laboratories analyzing bulk samples must be participating in an EPA approved round robin and must have participated in at least 50% of the rounds within the last year and scored 90% or better. Laboratories analyzing air samples must be American Industrial Hygiene Association (AIHA) and National Voluntary Laboratory Accreditation Program (NVLAP) accredited and be proficient in the NIOSH PAT program. Laboratories shall also hold current accreditation and licensure as an asbestos analytical laboratory, as appropriate, in the State where work is to be performed

1.1.5.7 Survey Reports. Include the following in the Asbestos Survey Report: single line floor plan drawings of the buildings and rooms showing where samples were taken; indexed schedule of samples surveyed with the sample number and other pertinent notes; narrative on methodology of survey. Correlate the laboratory bulk sample report numbers with the samples taken. Also include in the report recommended ACM or PACM to be abated and detailed cost estimates for the various abatement actions. Survey report shall also include:

- a. List of identified homogeneous areas classified by type of material.

- b. The location of friable and non-friable suspect material assumed to be ACM.
- c. Approximate square footage (SF) or linear footage (LF) of any homogeneous or sampling area where material samples were collected.
- d. A copy of the laboratory analyses for each bulk sample and designation as ACM or NON-ACM, as well as identification of type and percentage of ACM identified.
- e. Dates of sample analyses.

1.2 Applicable Publications.

The most current editions of the publications listed below constitute an addendum to this chapter wherever referenced or applicable.

Fed Std 313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
NIOSH	The National Institute for Occupational Safety and Health Manual of Analytical Methods, Physical and Chemical Analysis Method
OSHA	Occupational Safety and Health Administration 29 CFR 1910.1001 29 CFR 1926.1101
EPA	Environmental Protection Agency 40 CFR 61 Subparts A & M
EFARS	52.2/9009

Note: The above reference agencies may be contacted at the following addresses:

- a. The National Institute Occupational Safety and Health
CDC-NIOSH
Building J, N.E. Room 3007
Atlanta, Georgia 30333
- b. The Occupational Safety and Health Administration
200 Constitution Avenue
Washington, D.C. 20210
- c. Environmental Protection Agency
401 M. Street, S.W.
Washington, D.C. 20460

1.3 Pre-concept/Pre-project Definition (10%) Submittal Requirements. No requirements for this submittal.

1.4 Concept/Project Definition (30%30%) Design Submittal Requirements.

The 30% Design Submittal include:

- a. Criteria listing - standards, manuals, etc.
- b. Trip report, including a description of findings, samples locations, and test procedures.

- c. Written notifications of any highly contaminated, occupied areas which pose an immediate threat to the health of the occupants.
- d. Certification and/or experience of A-E or consultant performing asbestos sampling and asbestos abatement design.
- e. Name and certification of asbestos testing laboratory.
- f. Narrative describing anticipated scope of work.

1.5 Preliminary (60%) Design Submittal Requirements.

5.1 Preliminary (60%) Design Analysis.

1.5.1.1 The 60% Design Analysis includes all items contained in the 30% Design submittal and necessary changes as required.

1.5.1.2 Furnish laboratory test results with the project 60% Design Analysis verifying the existence of asbestos by type, concentration level (in percent), location, condition, and binder type (including percent). The analysis of vinyl floor tile and sheeting is an exception as noted earlier. Submit qualitative TEM analysis of sample test results reporting results as ">1% asbestos", "<1% asbestos trace", or "no asbestos detected". Negative Test reports are also required.

1.5.1.3 Include the Asbestos Survey Report as a separately bound volume or as an appendix to the Design Analysis.

1.5.2 Preliminary Drawings.

1.5.2.1 Submit drawing(s) at 60% design stage for all projects which contain asbestos.

1.5.2.2 Provide demolition or renovation drawing(s) which show any and all asbestos abatement work to be accomplished by the construction contractor.

1.5.2.3 Indicate on each drawing the location and type of asbestos with enough detail so that quantities can be estimated.

1.5.2.4 Include a schedule of occupancy phasing, if applicable.

1.5.2.5 In crawl spaces, where the dirt floor has been determined to be contaminated with asbestos, identify the area requiring abatement, selected abatement method, and indicate whether the material is friable or nonfriable.

1.5.2.6 Prepare asbestos abatement drawings for color reproduction or otherwise clearly delineate the asbestos work only.

1.5.2.7 Drawing numbers shall carry an "AH-" prefix.

1.5.2.8 If part of a larger set of drawings, then group all asbestos drawings together and place them immediately before the architectural drawings. Sheet and ring numbers shall follow sequentially with the other drawings in the set.

1.6 Final (90%) Design Submittal sRequirement

1.6.1 Final Design Analysis. The Final Design Analysis is a refinement of the 30% Submittal and the 60% Design Analysis. If the 60% stage is not required, the Final Design Analysis includes all items required in paragraphs 2.8 and 2.9.1 above.

1.6.2 Final Drawings.

1.6.2.1 Final plans are the refinement and completion of 60% drawings. All approved comments from this office relating to 30% and 60% Design are incorporated in the final drawings.

1.6.2.2 Where crowded conditions exist, provide sufficient sections and elevations to clearly indicate the exact location of the asbestos in relation to other items.

1.6.2.3 The number of floor plans, elevations, and details shall be sufficient to enable bidders to estimate the work.

1.6.3 Final Specifications.

1.6.3.1 Guide Specification CEGS-13280, or Modmaster Section 13281 are used as a guide for demolition and renovation projects which require asbestos abatement by removal, and will require editing to reflect specific project requirements.

1.6.3.2 Include a summary copy of the Asbestos Survey Report (with cost data removed) as an appendix to the asbestos specification or at the end of Section H, Special Contract Requirements if a large document. Add the following to the survey report cover:

"FOR INFORMATION ONLY – NOT FOR DESIGN OR CONSTRUCTION".

1.6.3.3 Include marked up draft and final typed specifications in the Final Design submittal package.

1.7 Corrected Final (100%) Design Submittal Requirements.

The 100% submittal is not considered a formal design level and is required only when the Final submittal must be revised or corrected due to errors or omissions. Incorporate the approved comments generated during the Final Design review into the 100% submittal.

1.8 Estimate.

Prepare a detailed cost estimate for the asbestos work and submit at the 60% and Final stages of the total project design effort. In preparing the Project Estimate, identify the cost of the asbestos abatement as a separate item for the various types and quantities of asbestos to be abated. Provide a detailed breakdown and backup data in the estimate for all costs, including the Industrial Hygienist Private Qualified Person (PQP) on the job, permit filing, air and final cleanup sampling and laboratory and analysis costs, labor cost for abatement work for each type of ACM to be abated, transportation cost, and disposal cost. Exclude cost estimate information in the Asbestos Survey Report from the contract documents.

1.9 Fee Proposal.

Identify materials sampling and laboratory test analyses as a separate item in the A-E fee proposal.

----END OF SECTION----

CHAPTER 17

OCCUPATIONAL HEALTH CONSIDERATIONS

1.0 REQUIREMENTS.

Many construction projects consist of demolition, renovation and/or additions to existing facilities. Many of these facilities contain hazardous materials such as lead, asbestos, polychlorinated biphenyl's (PCBs), mercury, and radon gas. Because of the potential health hazard to construction workers and occupants created by disturbance of these types of materials, specific investigation(s), if included in Appendix A of the design contract, must be made to determine the presence, extent, and procedures for removal and disposal or mitigation of these materials. The investigation generally consists of visual inspection of the existing facilities and site. If this indicates the potential for the presence of these hazardous materials, then appropriate testing must be accomplished. The location and extent of hazardous materials abatement must be shown on the drawings and appropriate specification used. Specifically, the A-E must accomplish the following actions during the design:

- a. Determine whether or not the above hazardous materials exist on the site or within material or equipment scheduled to be removed in the project.
- b. Discuss its mitigation, removal, disposal, and replacement with alternative non-hazardous material.
- c. The Design Analysis at the Concept/Project Definition (30% Complete) Submittal for all projects with new construction, demolition, renovation, and/or additions, must discuss whether or not these materials will be a factor during construction.
- d. Clearly show in the contract documents the construction contractor's responsibility concerning these materials. Statements such as "remove as necessary" or "Contractor is responsible for removal of any hazardous materials which may be encountered during construction" or "may contain" are inappropriate, unbiddable, and unsuitable to alert workers and occupants of a potential health hazard. The A-E is responsible for locating, quantifying and accurately depicting any hazardous materials which may be encountered during construction.
- e. Include each hazardous material abatement action separately in the cost estimate.

1.1 Prohibited Building Materials.

The use of the following materials is prohibited on all projects:

- a. Products containing asbestos.
- b. Products containing urea formaldehyde
- c. Products containing polychlorinated biphenyl's.
- d. Solder or flux containing more than 0.2 percent lead and domestic water pipe or pipe fittings containing more than 8 percent lead.
- e. Paint containing more than 0.06 percent lead.

1.2 Recycled Materials.

EPA guidelines require the use of recovered materials in Federally funded construction. Evaluate the potential use of recycled materials (fly ash and building insulation) to the maximum extent practical within the project boundaries. If recycled materials are inappropriate, document the reasons in the project design analysis.

1.2.1 If allowed, fly ash shall be used to replace up to 20 percent of portland cement in concrete mix designs.

1.2.2 It is recommended that building insulation have a minimum content of recovered material. If the specified amount of recycled material is not available for a given product, a lesser percentage is acceptable. These requirements do not apply to acoustic insulation, used in plumbing or HVAC systems or fireproofing.

1.3 Lead-Based Paint in Alteration or Demolition Projects.

When alteration or demolition requires sanding, burning, welding, scraping or removal of painted surfaces, test the paint for lead content using trained licensed and accredited personnel. When lead is found, implement the controls required by OSHA in 29 CFR 1926.62. Do not abate lead-based paint when a painted surface is intact and in good condition, unless required for alteration or demolition. In target housing and child-occupied facilities, test all painted surfaces for lead and abate all surfaces which contain lead-based paint. Lead-based paint abatement activities shall comply with the requirements of 40 CFR Part 745, 24 CFR Part 35, and other applicable Federal, State, and local requirements.

1.3.1 Evaluation. Prior to alteration design, an evaluation shall be performed on all suspect painted surfaces impacted by the project. This evaluation shall include review of inspection reports and a site inspection. If lead paint damage or the possibility of lead paint disturbance during construction activity is discovered, one of the following four corrective actions must be taken: removal, over- painting (encapsulation), enclosure or repair. The assessment must be performed by trained, licensed and accredited inspectors.

1.3.2 Design. All design drawings and specifications for lead-based paint abatement must be produced by a qualified specialist. The guiding standards for this work are the OSHA and EPA regulations, in particular 29 CFR 1926.62, 40 CFR 260-265 and 268, and 49 CFR 172 and 178. Lead-based paint abatement activities shall comply with the requirements of 40 CFR Part 745, 24 CFR Part 35 and other applicable Federal, State, and local requirements. Use CEGS-02090, Lead-Based Paint (LBP) Abatement and Disposal or Modmaster 13283. In general, projects shall be designed to avoid or minimize LBP disturbance.

1.3.3 Construction. All work that disturbs LBP must be specified to be performed using appropriate controls for the safety of workers, building occupants, and the public.

1.3.4 Inspections. If negotiated as Title II Services of the design contract, perform an inspection of the abatement work area and surrounding areas to protect the interests of the Government, the building occupants and the public. Such inspections shall include visual and physical inspection by X-ray fluorescence (XRF), supplemented with bulk sampling and analysis of paint scrapings if XRF is inconclusive. The collection of exterior surficial soil samples may also be appropriate. The purpose of the inspection is to test representative areas of the building impacted by the work for total lead and determine if painted surfaces contain sufficient concentrations of lead to be classified as lead-containing paint. Perform inspections under the supervision of a Certified Industrial Hygienist, Registered Architect, or Professional Engineer by trained and accredited individuals, who hold current licensure as a "Lead Inspector/Risk Assessor" in the state where the work is to be performed.

1.3.5 Laboratories. Laboratories analyzing samples for lead must be accredited by the American Industrial Hygiene Association (AIHA) or the National Institute for Standards and Technology's Voluntary Laboratory Accreditation Program. Laboratories performing the analyses must be an EPA National Lead Laboratory Accreditation Program (NLLAP) accredited laboratory and be rated proficient in the AIHA Environmental Lead Proficiency Analytical Testing Program (ELPAT). Certification must include accreditation for heavy metal analysis and expertise relevant to analysis of lead in air.

1.3.6 Submittals. Submit the LBP abatement design at each phase with the same degree of detail as for asbestos abatement design given in APPENDIX G of this Guide. Include appropriate drawings, specifications and separate cost estimate for LBP abatement. If both ACM and LBP are in the project, drawings may be combined.

1.4 Abatement of Asbestos in Existing Buildings.

1.4.1 Evaluation. Prior to alteration design, an evaluation shall be performed on all existing buildings impacted by the project. This evaluation shall include review of inspection reports and a site inspection. If asbestos damage or the possibility of asbestos disturbance during construction activity is discovered, one of the following four corrective actions must be taken: removal, encapsulation, enclosure or repair. The assessment must be performed by appropriately trained inspectors.

1.4.2 Design. All design drawings and specifications for asbestos abatement must be produced by a qualified specialist. The guiding standards for this work are the OSHA and EPA regulations, in particular 29 CFR 1926.1101, 40 CFR 61.140-157 and 49 CFR 171-180, and applicable State regulations. In general, projects shall be designed to avoid or minimize asbestos disturbance.

1.4.3 Construction. All work that disturbs asbestos must be performed using appropriate controls for the safety of workers, building occupants, and the public.

1.4.4 Inspections. If negotiated as Title II Services of the design contract, perform an inspection of the abatement work area and surrounding areas to protect the interests of the Government, the building occupants and the public. Such inspection shall include visual and physical inspection and bulk sample collection and analyses by Polarized Light Microscopy (PLM) and/or Transmission Electron Microscopy (TEM), as appropriate. Inspections shall be performed under the supervision of a Certified Industrial Hygienist, Registered Architect, or Professional Engineer by individuals accredited under the EPA Model Accreditation Plan (MAP), as Asbestos Building Inspectors, and holding current licensure as such in the State where the work is to be performed for asbestos.

1.4.5 Laboratories. Laboratories analyzing samples for asbestos must be accredited by the American Industrial Hygiene Association (AIHA) or the National Institute for Standards and Technology's Voluntary Laboratory Accreditation Program and licensed as may be appropriate in the State where the work is to be performed.

1.5 Radon Mitigation.

1.5.1 New Construction. If the potential for Radon release is identified in the geotechnical report or Appendix A of the design contract, measures shall be taken in the building design to keep radon levels below the lowest level identified by the EPA that would require remedial action.

1.5.2 Alterations. In existing buildings radon levels shall be tested if alterations cause changes in areas with slabs or walls in contact with the ground. The COE will advise the A-E if current or previous radon readings have exceeded the lowest EPA action level. If so, the COE will provide data which will permit an analysis of likely future radon levels by the A-E. Based on this analysis, mitigation features shall be incorporated into the design with the goal of protecting occupants from radon emissions at or above the lowest action level identified by the EPA.

1.5.3 Testing. Testing shall be performed by a company qualified to measure radon and radon decay products as demonstrated in the National Radon Measurement Proficiency (PMP) Program of the USEPA Office of Radiation Programs.

1.5.4 Design Considerations. The EPA is currently working on a draft document outlining construction methods to reduce radon hazard in buildings. Until this document is published, designers will need to rely on professional judgment for the design of mitigating measures. Useful sources of information for radon reduction techniques are

EPA/625/5-87/019, Radon Reduction Techniques for Detached Houses; **EPA/625/2-91/032**, Radon-resistant Construction Techniques for New Residential Construction; Army **ETL 1110-3-438** Indoor Radon Prevention and Mitigation, and Army **AR 200-1, Chap. 11**. Army **ETL 1110-3-438** provides action levels to consider for design purposes. Design concepts to consider include:

- a. Sealing of construction, expansion and seismic joints in slabs on grade.
- b. Sealing of all penetrations in foundation walls.
- c. Placement of a vapor barrier under slab on grade. All penetrations through the vapor barrier shall be sealed.
- d. Ventilating of crawl spaces.
- e. Installation of a sub-slab depressurization system, which consists of a grid of perforated pipe placed in the gravel layer below the vapor barrier and vented to the outside air.

1.6 Polychlorinated Biphenyls (PCB's).

Sample and test those items of equipment scheduled for removal that have been identified or suspected to be filled or contaminated with PCB's. Include laboratory test reports or visual inspection results in the Concept Design Analysis indicating room location, equipment number and concentration of PCB's for each piece of equipment. Unless otherwise directed, specify that all contaminated equipment, articles, and/or materials are delivered to the location designated by the Contracting Officer during the construction of this project. Clearly delineate the associated cost of removal on all construction cost estimates. Where disposal of PCB-containing or contaminated equipment, items, articles, or materials is to be accomplished by the construction contractor, provide a detailed cost estimate for the removal, handling, temporary storage, transport and disposal of such materials.

1.6.1 Design Considerations. Refer to 40 CFR 761, 49 CFR 171-180, and Modmaster Section 13286 for the removal/disposal of PCB-containing lighting ballasts, and mercury-containing lamps.

---END OF SECTION---

CHAPTER 18

QUALITY REVIEW PROCESS

1.0 APPLICABILITY: This Quality Review process applies to all products produced by Engineering Branch in-house forces, or others such as sister districts or Architect-Engineer (A-E) consultants. The purpose of the quality review process is to help ensure design quality of in-house and A-E designed HTRW, Civil, SFO, and Military projects.

2.0 POLICY: Each product prepared by Engineering Branch shall receive an Independent Technical Review (ITR) commensurate with its size, complexity, importance and utilization of innovative or unusual features. This review is normally the third step of the quality review process.

3.0 REFERENCES:

- a. ER 1110-1-12, QUALITY MANAGEMENT
- b. ER 1110-2-1200, PLANS AND SPECIFICATIONS FOR CIVIL WORKS
- c. ER 1110-345-100, DESIGN POLICY FOR MILITARY CONSTRUCTION
- d. ER 5-1-11, PROGRAMS AND PROJECT MANAGEMENT
- e. ER 415-1-11, BIDDABILITY, CONSTRUCTABILITY, OPERABILITY

4.0 DEFINITIONS:

4.1 Product means the assembled item to be delivered to a customer outside Engineering Branch such as studies, reports, programming documents, and the final design of a project, which includes drawings, specification, design analysis and cost estimate.

4.2 Design Check Review is the first step of the review process and is the evaluation of the analysis and the product documents performed by each functional discipline as an extension of the design process. Design checks shall be performed internal to the product development team (PDT) member's section. All checked drawings, computations and analyses shall be annotated to show the initials of the designer/originator and the checker. Each PDT member shall sign a certification verifying the Design Check Review(s) was accomplished. Design checklists should be used by each functional discipline to strengthen the design check process. Experience level of checker shall be commensurate with the level of complexity and risk. A design check should include an evaluation of:

- a. Correct application of methods;

- b. Adequacy of basic data;
- c. Correctness of calculations;
- d. Completeness of documentation;
- e. Compliance with guidance and standards;

4.3 Interdisciplinary Review is normally the second step of the review process and encompasses the day-to-day coordination between PDT members throughout the product development process. The interdisciplinary check ensures the portion of the product developed by one discipline does not conflict or interfere with the portion developed by another discipline. Although an on-going process, it shall be formally documented in a meeting(s) prior to completion of each predetermined milestone. This is also an opportunity for each member of the PDT to review the product as a whole. Each PDT member shall sign a certification verifying that all significant conflicts between their portion of the product and that of other team members have been satisfactorily resolved.

4.4 Independent Technical Review (ITR) is normally the third step in the review process and provides verification that a quality product is being provided in accordance with applicable references. ITR does not include detailed checks of each designer's work, which are performed during the earlier steps of the review process. The ITR shall normally be performed by functional section chiefs. However, if the functional section chief is involved in the design of the product, or cannot meet the ITR schedule, then the ITR may be delegated to other senior engineers within the functional discipline or a contract A-E firm or sister district, as applicable, who are not significantly involved in preparation of the product under review. Each ITR reviewer shall sign a certification verifying that the ITR was accomplished. The ITR shall ensure, as appropriate, that:

- a. The concepts, features, methods, analysis, and details are appropriate, fully coordinated and correct;
- b. The concepts, features, methods, analysis, and details of an appropriate range of feasible alternatives are evaluated;
- c. The problems/opportunities/issues are properly defined and scoped;
- d. The analytical methods used are appropriate and yield reliable results;
- e. The product is consistent with the Army's environmental policy of compliance, restoration, prevention, and conservation.
- f. The results and recommendations are reasonable, within policy guidelines, and supported by the presentation;
- g. Any deviations from policy, guidance, and standards are appropriately identified and have been approved;
- h. The product is cost effective.

4.5 Quality product means that the product complies with applicable criteria, the authorized scope of work and funds, the end-users' functional and other specific

requirements and that environmental and aesthetic features commensurate with the function and importance of the project have been incorporated, as applicable.

4.6 Significant involvement means: Direct personal selection of a prominent system, project feature, or result; personal performance of analyses, comparisons or formulation of recommendations; selection of alternatives, methods, parameters, or judgmental factors to an extent which confers control.

5.0 RESPONSIBILITIES:

5.1 The Project Engineer or Project Architect (PA/PE) shall:

5.1.1 Ensure that the schedule, budget and deliverable items for each product are adequate for review. Items to consider include:

- a. Concurrent activities will most likely be under way.
- b. Provide adequate copies of products to avoid delay.
- c. Conformance with technical and project criteria and other specified guidance to minimize cost and duration of review.
- d. Review at early stages, including criteria preparation, can be the most effective use of review budget.

5.1.2 Provide advance notice to applicable Section Chiefs when the normal review duration of 15 working days is not available so alternate means of obtaining independent review can be developed if necessary.

5.1.3 Ensure that comments with cost implications are copied to Cost Engineering Section.

5.1.4 Ensure that the Project Manager (PM) is notified in a timely manner when conflicts are identified between the authorized scope of work, the authorized funding, and/or other criteria which could effect the quality of the end prevent.

5.1.5 Notify applicable branch or section chief(s) of any repetitive deficiencies or problems.

5.1.6 Arrange for mandatory reviews by centers of expertise, and/or review by others when specialized expertise is not available from Engineering Branch sources.

5.1.7 Establish the project in the Dr. Checks Review System, as applicable, and route reviews to PDT members.

5.1.8 Manage review comments to minimize conflicting comments and provide comments, which lead to a quality product.

5.1.9 Promptly provide responses to reviewers allowing time for resolution of all comments without affecting project schedule.

5.1.10 Place a copy of review comments with responses in the project file.

5.1.11 Provide written notice to A-E coordinator of poor A-E firm performance with a synopsis suitable for transmittal to contract A-E firms as the basis for BELOW AVERAGE or POOR performance evaluations. Include a copy to Chief, Engineering Branch.

5.2 Section Chiefs shall:

5.2.1 Assign designers and reviewers to projects.

5.2.2 Participate in the ITR process, to the extent practicable, or delegate ITR to experienced senior engineers within the functional discipline, or others, as applicable, who are not significantly involved in preparation of the product under review.

5.2.3 Ensure the detailed check of individual designers' work, in the Design Check step of the review process, as otherwise required but not included in the ITR of the assembled product.

5.2.4 Develop methods of preventing repetitive deficiencies, incorporate appropriate guidance in a design guide, or elevate consistently unrealistic expectations for resolution.

5.2.5 Determine technical adequacy of work within their area of responsibility.

5.3 Reviewers shall:

5.3.1 Make objective and relevant comments in a professional tone. Statements of personal preferences will be avoided. Comments will be structured to indicate:

- a. Reviewer identity
- b. The document reviewed
- c. Subject feature of the comment and its location in the document
- d. The criteria violated, error, unfulfilled user need, or suggested improvement.

5.3.2 Evaluate responses and, if necessary, participate in resolution of comments they have made or comments by others, which impinge upon their comments.

5.3.3 Present repetitive deficiencies to the applicable branch or section chief.

5.4 Designers shall:

5.4.1 Develop quality products as defined previously.

5.4.2 Notify the PA/PE when changes are discovered which may prevent delivery of a quality product and/or affect budget and/or schedule.

5.4.3 Participate in resolution of comments applicable to their work.

5.4.4 Respond to comments or suggestions. Responses will be relevant and in a professional in tone, and where the response is negative, cite applicable criteria, user functional needs, or elements of good engineering practice, as applicable.

5.4.5 Notify applicable branch or section chief(s) of any repetitive deficiencies or problems requiring or incorporation into a Design Guide.

5.5 Chief, Engineering Branch shall:

5.5.1 Ensure that repetitive deficiencies, and repetitive unrealistic expectations are addressed and dealt with in an effective manner.

5.5.2 Review the ITR process at least once a year and make appropriate changes, if required.

5.5.3 Resolve issues that cannot be resolved at lower levels.

5.6 Documentation:

5.6.1 Design Check Reviews: All calculations will be initialed and dated by the design team member and the checker. At the completion of this review, the Design Checker will sign a Certificate of Completion – Design Check and send it to the appropriate PA/PE. The PA/PE will compile all required forms and forward them to the PM for inclusion in the project file.

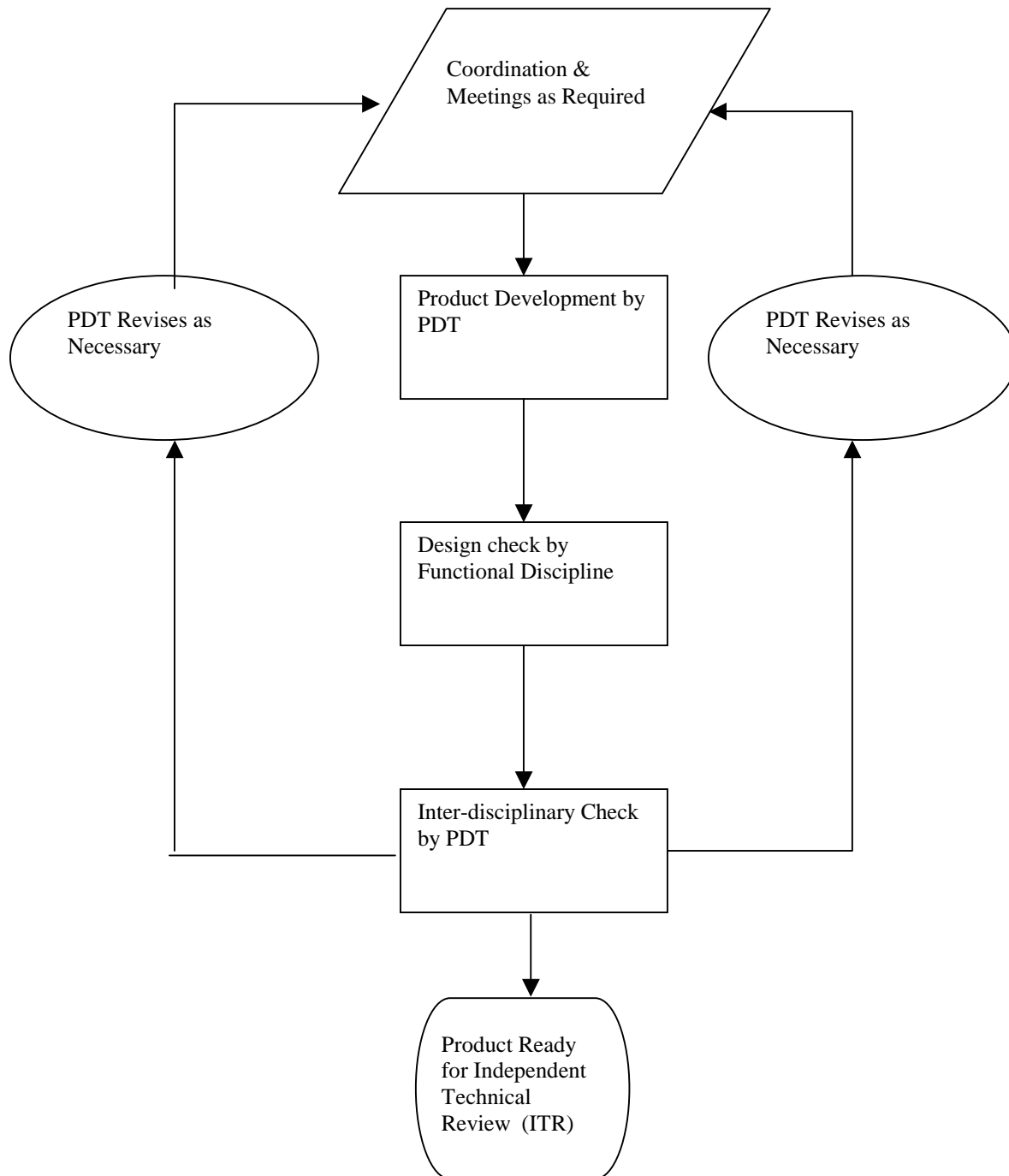
5.6.2 Interdisciplinary Reviews: Each designer will be responsible to review their own design and those portions of other disciplines' designs that interface with theirs to make sure the designs are coordinated. Designers will incorporate all necessary revisions from the Interdisciplinary Check. At the completion of this review, the reviewer will sign and date the

Certificate of Completion - Interdisciplinary Check and send it to appropriate PA/PE. The PA/PE will compile the required forms and forward them to the PM for inclusion in the Project File.

5.6.3 Independent Technical Review (ITR): When all revisions from the Interdisciplinary Check are completed, the PA/PE will ensure that the appropriate numbers of copies of the design documents are reproduced for the ITR. The Section Chief of the lead section will assemble the Quality Reviewers of each discipline (Review Team) in a conference room, as applicable, with copies of the design documents for the ITR. Each ITR reviewer will review their disciplines' design plus those portions of other discipline's designs that interface with their discipline. Reviewers will document required changes by showing the design changes or writing notes on the drawings/specs/DA. At the completion of this ITR review, each reviewer will initial and date their discipline's drawings. The Section Chief of the lead section will have the ITR team members sign and date the Certificate of Completion - ITR and send it to appropriate PA/PE. The PA/PE will consolidate the required information and forward it to the PM for inclusion in the Project File.

APPENDIX A

IN-HOUSE PRODUCT DEVELOPMENT PROCESS



APPENDIX B

EXAMPLE MILITARY CHECKLIST

The enclosed example Military Checklist is taken from the ER 1110-1-12. Checklists for HTRW and Civil Works projects are included in ER 1110-1-12, but are not reiterated here. This checklist is intended to serve only as a guide in checking or reviewing design documents for errors and omissions. It cannot substitute for the exercise of sound engineering judgement by reviewers. Professionals must maintain control of their decisions, understand the technical basis for those decisions, and independently evaluate significant data upon which the design decisions are based. The main usefulness of a checklist such as this is to provide a "minimum" check of consistency between disciplines, and compatibility of drawings to specifications. It is expected that it will be modified by each USACE command to fit specific requirements. Each item in the checklist should be checked off to indicate that the item has been reviewed, or marked "NA" to indicate it is not applicable.

Verify:

A. GENERAL:

- _____ 1. That all documents have been logically ordered and a table of contents provided.
- _____ 2. That all documents have been signed and dated.
- _____ 3. That the scale and orientation of the drawings are consistent throughout the complete set of drawings.
- _____ 4. That SOW shown in the design submission has been checked against the official 1391 and current design directive.
- _____ 5. That all real estate planning reports have been reviewed to identify real estate constraints.
- _____ 6. That appropriate elements have been notified of any additional real estate requirements.
- _____ 7. Schedules and budgets are in accordance with PMP.

B. CIVIL:

- _____ 1. Existing and proposed grades.
- _____ 2. That haul routes, disposal/borrow sites, construction contractor's storage area, construction limits, and construction staging area are shown.
- _____ 3. Existing utilities.
- _____ 4. That new underground utilities have been checked for conflicts against the site plans.
- _____ 5. That utility tie-in locations agree with mechanical stub out plan.
- _____ 6. That profile sheets show underground utilities and avoid conflicts.
- _____ 7. That property lines and limits of clearing, grading, turfing, or mulch have been shown and are consistent with architectural and/or landscaping plans.
- _____ 8. That fire hydrant and power/telephone pole locations correspond with electrical and architectural drawings.
- _____ 9. That basis of horizontal and vertical control is given and the control points are located properly with pertinent data shown: i.e., elevations, coordinates, stationing, and/or start of construction.
- _____ 10. That valve boxes and manholes match final finished grades or pavement, swales, or sidewalks.
- _____ 11. That boring locations, soil classifications, water table, and depth of rock are shown on the plans.
- _____ 12. That rigid pavement joint plans are shown with reasonable spacing.
- _____ 13. That foundation coordinates are shown on the foundation plan and coordinated with architectural drawings.
- _____ 14. That finished floor elevations match on architectural and structural drawings.
- _____ 15. That civil specifications are coordinated with plans.
- _____ 16. That storm and sewage drains from the facility have adequate capacity.
- _____ 17. That directions to contractors are not duplicated in plan notes and in the specifications.

C. LANDSCAPE:

- _____ 1. That the sprinklers, lighting, hardscape, etc., correspond with the site limits, including the building and civil plans.
- _____ 2. That maintenance of landscape has been provided for in the design documents.

D. STRUCTURAL:

- _____ 1. That the design load conditions meet or exceed the Building codes and the Design Standards.
- _____ 2. That the column orientation and grid lines on the structural and the architectural drawings match.
- _____ 3. That the load-bearing walls and the column locations match with architectural drawings.
- _____ 4. That the slab elevations match the architectural drawings.
- _____ 5. That the depressed or raised slabs are indicated and match the architectural drawings.
- _____ 6. That the limits of slabs on the structural drawings match the architectural drawings.
- _____ 7. That the expansion joints through the structural drawings match the architectural drawings.
- _____ 8. The footing depths and coverage with the existing and final grades.
- _____ 9. That the foundation piers, footings, grade beams are coordinated with schedules.
- _____ 10. The footing and pier locations with the new and existing utilities, trenches, and tanks.
- _____ 11. That the foundation wall elevations are the same as on the architectural drawings.
- _____ 12. That the location of floor and roof framing column lines and column orientation match the foundation plan column lines and column orientation.
- _____ 13. That the structural perimeter floor and roof lines match the architectural drawings.
- _____ 14. That the section and detail call outs are proper and cross-referenced.

- _____ 15. That the columns, beams, and slabs are listed in schedules and are coordinated.
- _____ 16. That the column length, beam, and joist depths match with the architectural drawings.
- _____ 17. That the structural dimensions match the architectural drawings.
- _____ 18. That the drawing notes do not conflict with specifications.
- _____ 19. That the architectural construction and rustication joints are correct.
- _____ 20. The structural openings are coordinated with the architectural, mechanical, electrical, and plumbing drawings.
- _____ 21. The structural joist and beam location do not conflict with water closets, floor urinals, floor drains, and chases.
- _____ 22. The structural design roof and floors for the superimposed loads, including the HVAC equipment, boilers, glass walls, etc.
- _____ 23. Cambers, drifts, and deflections with the architectural drawings.
- _____ 24. That the concentrated load points on joists do not conflict with design by other disciplines; i.e., large water lines or fire main lines.
- _____ 25. That horizontal and vertical bracing, ladders, stairs, and framing do not interfere with doorways, piping, duct work, electrical, equipment, etc.
- _____ 26. That the structural fire proofing requirements are coordinated with the architectural requirements.
- _____ 27. That the rock excavation is a base bid or a unit price.

E. ARCHITECTURAL:

- _____ 1. That site property lines and existing conditions match with survey or civil drawings.
- _____ 2. That building location meets all setback requirements, zoning codes, and deed restrictions.
- _____ 3. That building limits match with civil, plumbing, and electrical on-site plans.

- _____ 4. That locations of columns, bearing walls, grid lines, and overall building dimensions match structural.
- _____ 5. That locations of expansion joints, at all floors, roof and walls, match with structural drawings, and that locations of masonry control joints are shown on plans and elevations and coordinated with structural drawings.
- _____ 6. That demolition instructions are clear on what to remove and what is to remain, and are coordinated with design documents.
- _____ 7. That building elevations match floor plans and have the same scale.
- _____ 8. That building sections match elevations, plans, and structural drawings.
- _____ 9. Building plan match lines are consistent on structural, mechanical, plumbing, and electrical drawings.
- _____ 10. Structural member locations are commensurate architecturally.
- _____ 11. That elevation points match with structural drawings.
- _____ 12. That chases match on structural, mechanical, plumbing, and electrical drawings.
- _____ 13. That section and detail call outs are proper and cross-referenced.
- _____ 14. That large-scale plans and sections match small scale plans and sections.
- _____ 15. Reflected architectural ceiling plans are coordinated with mechanical, and electrical plans.
- _____ 16. That columns, beams, and slabs are listed on elevations and sections.
- _____ 17. That door schedule information matches plans, elevations, fire rating, and project manual.
- _____ 18. That cabinets or millwork will fit in available space.
- _____ 19. That flashing through the wall and weep holes are provided where moisture may penetrate the outer material.
- _____ 20. Flashing materials and gauges.
- _____ 21. Fire ratings of walls, ceilings, fire and smoke dampers.

- _____ 22. That miscellaneous metals are detailed, noted, and coordinated with the Project Manual.
- _____ 23. That equipment rooms or areas are commensurate with mechanical, electrical, and plumbing needs.
- _____ 24. The limits, types, and details of waterproofing are coordinated with design documents
- _____ 25. The limits, types, and details of insulation are coordinated with design documents and insulation R values are shown on the drawings.
- _____ 26. The limits, types, and details of roofing and coordination with design documents.
- _____ 27. Skylight structures compatibility with structural design.
- _____ 28. That piping loads hang from the roof or floors, are coordinated with mechanical and structural drawings, and proper inserts are called for on the drawings.
- _____ 29. That all mechanical and electrical equipment is properly supported and that all architectural features are adequately framed and connected, and, that sleeves are noted on foundation plans for mechanical/electrical/communication work.
- _____ 30. That all drawings showing monorails, hoists, and similar items have support details, notes, and that the locations are coordinated with the architectural, structural, mechanical, and electrical drawings.
- _____ 31. That walls, partitions, and window walls are not inadvertently loaded through deflection.
- _____ 32. That all window walls, expansions, and weeps are provided.
- _____ 33. That all handicapped requirements are coordinated with plumbing and electrical.
- _____ 34. That architectural space requirements are commensurate with duct work, conduit, piping, light fixtures, and other recesses.
- _____ 35. That architectural space requirements are commensurate with elevators, escalators, and other equipment.
- _____ 36. Dew point in walls, roof, and terraces are satisfactory, and that a vapor barrier has been provided as required.

_____ 37. That concealed gutters are properly detailed, drained, waterproofed, with expansion provided for, and, that downspouts/rain leaders fit in designated spaces and that splash blocks are located and detailed.

_____ 38. Compatibility of grading around perimeter of building with civil drawings.

_____ 39. That color finish schedules are included in documents.

_____ 40. That interior valleys for buildings having large flat roofs are provided with saddles or crickets to eliminate formation of bird baths.

_____ 41. That all shelving, hang rods, casework and bath accessories are identified and specified.

_____ 42. That stairs, corridors and landings provide code required width and length and structure, handrails and stringers do not interfere with required clearance.

F. MECHANICAL:

_____ 1. That mechanical plans match electrical plans, architectural plans, and reflected ceiling plans.

_____ 2. That HVAC ducts are commensurate with architectural space and are not in conflict with conduit, piping, structures, etc.

_____ 3. That mechanical equipment fits architectural space with room for access, safety, and maintenance and that access clearance is shown on the mechanical plans.

_____ 4. That mechanical openings match architectural and structural drawings.

_____ 5. That mechanical motor sizes match electrical schedules.

_____ 6. That thermostat locations are not placed over dimmer controls.

_____ 7. That equipment schedules correspond to manufacturer's specifications and design documents.

_____ 8. Mechanical requirements are shown for special equipment; i.e., kitchen, elevator, telephone, transformers, etc.

_____ 9. Fire damper location in ceiling and fire walls.

_____ 10. That all structural supports required for mechanical equipment are indicated on structural drawings.

_____ 11. That all roof penetrations are shown on roof plans.

_____ 12. That seismic bracing details are provided for all platforms which support overhead equipment and that seismic flexible coupling locations and details are shown.

G. FIRE PROTECTION:

_____ 1. Conduct waterflow testing for all new sprinkler systems. Indicate waterflow test data on drawings or in specifications.

_____ 2. Provide detailed hydraulic calculations that verifies that the water supply is sufficient to meet the fire protection system demand.

_____ 3. Ensure that a complete riser diagram is shown, and coordinate clearance from other equipment.

_____ 4. Ensure that all piping from the point of connection to the existing, to the top of the sprinkler riser(s) is shown on the drawings.

_____ 5. Ensure that all valves, fire department connections, and inspector's test connections are indicated on drawings.

_____ 6. Ensure that sprinkler main drain piping and discharge point are shown and detailed. Main drains should discharge directly to the outside.

_____ 7. Ensure that the extent of limit of each type of sprinkler system, each design density, each type and temperature rating of sprinkler heads, and location of concealed piping is clearly specified or shown.

_____ 8. Ensure that water-filled sprinkle piping is not subject to freezing.

_____ 9. Provide detail of the sprinkler piping entry into the building, and include details of anchoring and restraints.

_____ 10. Ensure that aesthetics considerations are incorporated in the design of the sprinkler system, e.g., sprinkler piping is concealed in finished areas and recessed chrome-plated pendent sprinkler heads are used in finished area.

_____ 11. Ensure that paddle-type waterflow switches are only used in wet-pipe sprinkler systems. The other sprinkler systems shall use pressure-type flow switches.

- _____ 12. Ensure that the main sprinkler control valves are accessible from the outside.
- _____ 13. Ensure that fire rating of fire-rated walls, partitions, floors, shafts, and doors are indicated.
- _____ 14. Ensure that if spray-applied fire proofing is specified that the fire rating of the steel structural members are indicated.
- _____ 15. Ensure that the location of required fire dampers are shown.
- _____ 16. Ensure that the location of all fire alarm indicating devices, pull stations, waterflow switches, detectors, annunciation panel, and other fire alarm and supervisory devices are indicated on the drawings.
- _____ 17. Ensure that the connection of the fire alarm and detection system to the base-wide fire alarm system is clearly shown and detailed and coordinated with electrical drawings.
- _____ 18. Coordinate with civil and landscape any requirements for 'detector-check'.

H. PLUMBING:

- _____ 1. That the plumbing plans match architectural, mechanical, and structural drawings.
- _____ 2. That plumbing fixtures match plumbing schedules and architectural locations.
- _____ 3. Compatibility of site piping limits interfaces with building piping.
- _____ 4. Roof drain locations with roof plan.
- _____ 5. That subsurface drains are located and detailed.
- _____ 6. That roof drain overflows are provided.
- _____ 7. That piping chase locations matches architectural and structural drawings.
- _____ 8. That all hot and cold water piping is insulated in accordance with the contractor's approved piping insulation display sample.
- _____ 9. That piping is commensurate with architectural space and not in conflict with conduit, duct, and structure.
- _____ 10. That piping openings match architectural and structural drawings.

- _____ 11. That structural design is compatible with plumbing equipment and piping requirements.
- _____ 12. That plumbing equipment schedules correspond to manufacturers' specifications and design documents.
- _____ 13. That floor drains match architectural and kitchen equipment plans.
- _____ 14. That site utilities have been accurately verified, and that site water and gas service requirements are met by supply utilities.
- _____ 15. That floor openings, i.e., drains, water closets, etc., do not conflict with structural beams, joists, or trusses.
- _____ 16. Limits and confines where piping may be run.
- _____ 17. That seismic bracing details are provided and that seismic flexible coupling locations are shown.
- _____ 18. That roof drain details are coordinated with other trades to show the installation of sump pans in ribbed sheet metal decks, and the placement of roof insulation in and around the drainage fitting.
- _____ 19. That sump pumps are provided for elevator pits.
- _____ 20. That oil/water separators are coordinated with civil.

I. ELECTRICAL:

- _____ 1. That electrical plans match architectural, mechanical, plumbing and structural.
- _____ 2. That location of light fixtures, speakers, etc., match with reflected ceiling plans.
- _____ 3. That electrical connections are shown for equipment, i.e., mechanical motors, heatstrips, etc., architectural, overhead doors, stoves, dishwashers, etc.
- _____ 4. That locations of panel boards, transformers, are shown on architectural, mechanical, and plumbing plans.
- _____ 5. That conduit chase locations match with architectural and structural drawings.

- _____ 6. Compatibility of conduit and light fixtures with architectural space and that no conflicts exist with duct, piping, or structure.
- _____ 7. That electrical equipment structural requirements are met.
- _____ 8. That electrical equipment room fits architectural space, with clearance for safety and maintenance.
- _____ 9. That electrical horsepower, voltage, phasing for all motors match on mechanical and architectural designs.
- _____ 10. That fixtures, speakers, clocks, etc., schedules correspond to a manufacturer's description and design documents.
- _____ 11. Light fixture spacing and location to eliminate dark spots.
- _____ 12. Location of duplex outlets, telephone, fire alarms clock outlets, etc., with architectural millwork and finishes.
- _____ 13. The limits and confines where conduits may be run.
- _____ 14. Site electrical and telephone service requirements with supply utility.
- _____ 15. That seismic bracing details are provided and that seismic flexible coupling locations are shown.

J. SPECIFICATIONS:

- _____ 1. That bid and additive items are coordinated with drawings.
- _____ 2. That the measurement and payment section is present, when appropriate.
- _____ 3. That construction phasing is clear.
- _____ 4. That cross-referenced specifications and drawing are numbered correctly.
- _____ 5. That all finish materials listed in architectural finish schedule are specified.
- _____ 6. That thicknesses and quantities of materials shown on plans agree with specifications.
- _____ 7. That all items of material or equipment are covered by adequate specifications, including those not covered by CEGS.

- _____ 8. That all shop drawings and material certifications to be submitted are listed in the submittal register.
- _____ 9. That provider of utilities during construction is indicated in specifications.
- _____ 10. That asbestos abatement and quantities are included in specs and on bid schedule.
- _____ 11. That Government-furnished materials are identified.
- _____ 12. That security requirements for employees are included.
- _____ 13. That references to test methods, material specs, or other manuals are consistent with civil or military designations, as applicable.
- _____ 14. That traffic control during construction is indicated.
- _____ 15. That temporary dust control measures are outlined.
- _____ 16. That proper warranties are called for in the specifications.

APPENDIX C**SAMPLE DESIGN AND REVIEW TEAM MEMBER FORM**
DESIGN TEAM AND INDEPENDENT TECHNICAL REVIEW TEAMS

PROJECT: _____

PRODUCT: _____

PA/PE/DTL: _____

REVIEW TEAM LEADER: _____

DATE: _____ PAGE: ____ of ____

Discipline	Design Team Members	Phone/Fax/E-Mail	Review Team Members	Phone/Fax/E-Mail

APPENDIX D

EXAMPLE SIGN-OFF SHEETS DESIGN CHECK REVIEW VERIFICATION

PROJECT:
PRODUCT:
PRODUCT PHASE:
PA/PE/DTL:

Check One:

_____ Input provided in this submittal

_____ No input required for this submittal

Description of Assignment:

I hereby certify that the input provided by this section for the above project has undergone a DESIGN CHECK REVIEW and is of adequate quality and detail for this phase of the product.

Signature:

Name:

Date:

Section:

INTERDISCIPLINARY REVIEW VERIFICATION

PROJECT:
PRODUCT:
PRODUCT PHASE:
PA/PE/DTL:

Check One:

_____ Input provided in this submittal

_____ No input required for this submittal

Description of Assignment:

I hereby certify that the input provided by this section for the above project has undergone an INTERDISCIPLINARY REVIEW and is of adequate quality and detail for this phase of the product.

Signature:

Name:

Date:

Section:

INDEPENDENT TECHNICAL REVIEW (ITR) VERIFICATION

PROJECT:
PRODUCT:
PRODUCT PHASE:
PA/PE/DTL:

Check One:

_____ Input provided in this submittal

_____ No input required for this submittal

Description of Assignment:

I hereby certify that an Independent Technical Review (ITR) was conducted on the above project, appropriate to the complexity and level of risk inherent in the project. This product complies with applicable criteria, the authorized scope of work, and meets the customer's needs.

Section Chief or ITR Designee Signature:

Name:

Date: